Stormwater Capacity Analysis for Potomac River, City of Alexandria, Virginia

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Executive Summary

The City of Alexandria, Virginia (the City), has experienced repeated and increasingly frequent flooding events attributable to old infrastructure, inconsistent design criteria, and perhaps climate change. The purpose of the stormwater capacity analysis project is to provide a program for analyzing storm sewer capacity issues, identifying problem areas, developing and prioritizing solutions, and providing support for public outreach and education. The project is being implemented in phases by watershed. The watersheds include Potomac River, Hooffs Run, Four Mile Run, Holmes Run, Cameron Run, Backlick Run, Strawberry Run, and Taylor Run.

This technical memorandum (TM) focuses on hydrologic and hydraulic analyses of Potomac River watershed using xpswmm. It summarizes the storm sewer system in the Potomac River watershed, the model

development steps, data sources and gaps, model assumptions, and the results, focusing on the capacity deficiencies identified in the model. These deficiencies will be used as a basis for identifying and prioritizing problem areas during the next phase of the project.

The objective of this phase of the study is to identify the deficient stormwater collection system elements in Potomac River during a 10-year return period rainfall event. During the Hooffs Run watershed modeling task, three different design storm scenarios and one historic event were investigated: the City's existing intensity-duration-frequency (IDF) curve, the updated IDF curve using the full record of historical precipitation data (1949 to 2008), the IDF curve projected for the year 2100 using various climate change scenarios, and the June 25–27, 2006 storm event. The results of the Hooffs Run analyses showed that the existing IDF design hyetograph was the most conservative of the design storms (produced the greatest amount of stormwater runoff and flooding), and produced a similar amount of the system flooding to the results from the historic event. Consequently, this scenario was chosen to be used to complete the stormwater capacity analysis for the other watersheds.

The Potomac River watershed has a drainage area of 1.3 square miles located along the eastern-most edge of the City, bounded to the west by Four Mile Run, Hooffs Run, and Cameron Run (East) watersheds and two of the City's combined sewersheds, Pendleton and Royal Street. Four Mile Run and the Potomac River provide the northern and eastern bounds. The watershed is predominantly drained by the Potomac River. In Old Town Alexandria, stormwater is conveyed directly to the Potomac through small, distributed systems. Runoff from the northern portion of the watershed, which primarily includes Potomac Yards, is either discharged into Four Mile Run near its confluence with the Potomac River or into wetlands around the George Washington Parkway that eventually discharge into the Potomac River. The Potomac River storm sewer system model is composed of 1,402 junctions and 1,364 segments of storm sewer pipe, totaling about 20 miles.

The hydraulic model predicts that the Potomac River storm sewer system is experiencing capacity deficiencies in a few areas within the watershed. Approximately 9 percent of the analyzed pipes flood the ground surface, 9 percent have a hydraulic grade line within 2 feet of the surface, and 13 percent surcharge above the crown of the pipe. Comparing the peak runoff to the estimated inlet capacity of each catchment indicates that 26 percent of the catchments in the model may have insufficient inlet capacity. Capacity limitations are predominantly located in older developments within the watershed, in Old Town Alexandria, and in developments adjacent to Potomac Yards. Maps and profiles of flooding areas are presented in this TM to assist in locating problem areas and understanding the capacity deficiencies of the drainage system.

The hydraulic modeling results presented in this TM should be reviewed with the understanding that several assumptions were made to fill data gaps, primarily assumptions of inverts in pipes with diameters less than 24 inches. It is also important to note that while the focus of this study is on drainage issues associated with drainage conveyance systems in the City of Alexandria that are designed for the 10-year, 24-hour storm, the City recognizes that flooding can also result from flood crest elevations in the surrounding rivers. To that end, the city has embarked on flood mitigation project for the Potomac River waterfront that includes a number of elements that are not related to storm sewer capacity, including a new flood wall or bulkhead, a promenade and park along the waterfront, and two new pump stations.

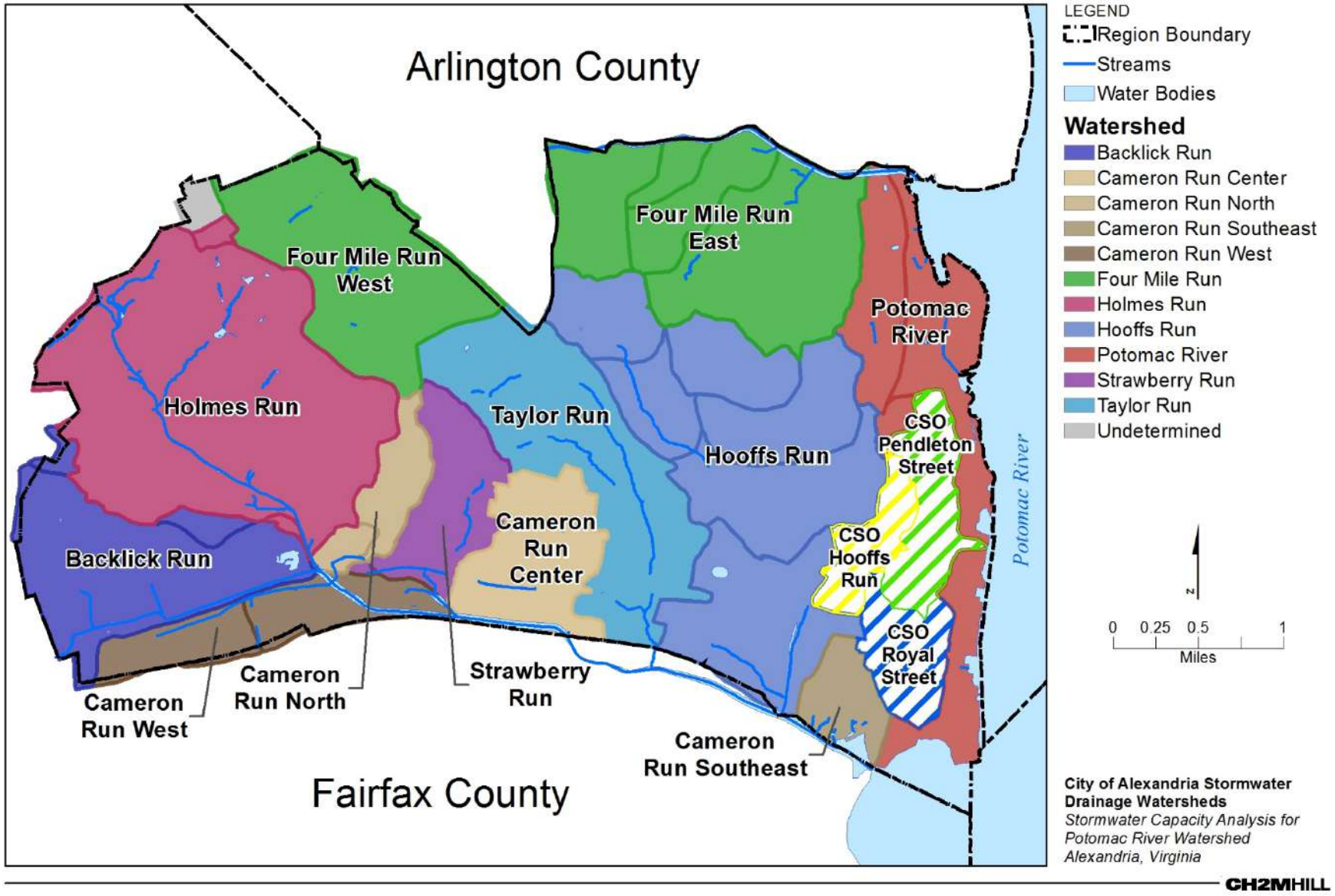
Project Introduction

The City of Alexandria, Virginia (the City), has experienced repeated and increasingly frequent flooding events attributable to old infrastructure, inconsistent design criteria, and perhaps climate change. The purpose of this project is to provide a program for analyzing storm sewer capacity issues, identifying problem areas, developing and prioritizing solutions, and providing support for public outreach and education. The project is being implemented by watershed. The watersheds include Potomac River, Hooffs Run, Four Mile Run, Holmes Run, Cameron Run, Backlick Run, Strawberry Run, and Taylor Run.

The purpose of this task is to conduct stormwater capacity analysis for the City's existing stormwater collection system within the Potomac River watershed. Figure 1 presents the various drainage sewersheds for the City of Alexandria. This TM describes the methodology and results of the stormwater capacity analysis for the stormwater collection system in the Potomac River watershed identified in Figure 1.

Additional TMs describe the results for additional watersheds in the City.

FIGURE 1
Stormwater Drainage Watersheds, City of Alexandria, Virginia
City of Alexandria Storm Sewer Capacity Analysis – Potomac River



Task 2 Objectives

The objective of this phase of the study was to identify the deficient stormwater collection system elements during a 10-year return period storm event. The stormwater collection system elements include the following:

- Closed conduits, such as gravity mains (storm drains) and culverts
- Open channels, such as streams and trapezoidal channels that connect two-pipe systems
- Drainage inlets and junctions, such as roadside curb inlets, manholes, catch basins, ponds
- Flow regulating structures, such as weirs, orifices, and tide gates

Description of Existing Stormwater Collection System

The City maintains a geodatabase of all stormwater collection system elements, including conduits and drainage junction points. A checked-out copy of the Potomac River geodatabase received from the City on April 17, 2015 was used as the basis of the stormwater collection system model.

Potomac River watershed has a drainage area of 1.3 square miles that was subdivided into 195 catchments for modeling purposes. The watershed is located on the eastern edge of the City and bounded on the east by the Potomac River. Overall, the Potomac River watershed can be divided into two major areas, Potomac Yards and its surroundings and Old Town Alexandria. Potomac Yards and adjacent drainage areas constitute the northern portion of the Potomac River watershed, predominantly lying above Slaters Lane. Runoff from this area is conveyed either to Four Mile Run near the confluence with the Potomac River or to wetlands adjacent to the George Washington Parkway. The southern portion of the watershed consists of the eastern most edge of Old Town Alexandria. Stormwater in this area is conveyed through small, distributed collection systems and is discharged through 16 separate outfalls directly into the Potomac River. Developed areas of the Potomac River watershed do not have any significant natural drainage systems. Undeveloped areas surrounding the George Washington Parkway and on Daingerfield Island include wetlands and small streams that convey runoff to the Potomac River.

The geodatabase was thoroughly reviewed and updated with new survey data for conduits with diameter 24 inches and larger collected during Task 3, a Field Survey and Condition Assessment. In some locations for which survey data were not available, the City's plan and as-built drawings were used to improve data quality and rectify system connectivity. Because of recent and ongoing development in the Potomac Yards area, significant portions of the stormwater collection system were not captured in the City's geodatabase or during survey efforts. In this area, approximately 600 new pipes and associated structures were added to the City's geodatabase based on review of available approved site plans. Invert, rim, and diameter data was gleaned from the plans, where available, to facilitate the development of the hydraulic model described in this TM. This information was not included in the City's geodatabase at the request of the City because of the level of accuracy of site plan approved documents compared to as-builts. Once this area is fully developed, the City's geodatabase should be updated with information from as-builts or survey data.

The updated geodatabase was submitted to the City for incorporation (i.e., checked-in) into the City-wide stormwater collection system geodatabase. The updated stormwater collection system in the Potomac River watershed contains the following elements:

- 1,720 pipe segments representing 129,466 linear feet of gravity mains (storm drains). Pipe diameter/width varies from 8 to 96 inches for circular, rectangular, and elliptical.
- 1,861 drainage junction points:
  - 13 catch basins
  - 17 culvert points
  - 1,099 drainage inlets

- 558 manholes
- 68 nodes (blind connections)
- 98 pipe inlet/outlets
- 4 control devices
- 4 storage basins (stormwater ponds)

The existing stormwater collection system includes four stormwater ponds and control devices, and one detention chamber. The Potomac Yards development contains three ponds, identified as Dry Pond P-1, Wet Pond P-2, and Wet Pond P-3 on as-builts and plan drawings. Dry pond P-1 is located at the northern most end of the watershed and Wet Ponds P-2 and P-3 are both located along Potomac Avenue in the Potomac Yards development. Wet Pond P-2 was originally constructed as a single pond, but review of plan drawings and as-builts indicate that a second wet pond was constructed that may have originally been hydraulically linked to the original pond and now operates independently. As-built drawings from 2013 show a new retaining wall and outlet structure were constructed on the southern side of the new wet pond. This pond is represented in the geodatabase as a single-pond feature with Facility identification of 000016PD. But in the model, Wet Pond P-2 is modeled as two separate ponds, 000016PD-N (north pond) and 000016PD-S (south pond), with two separate control devices. There is one additional wet pond in the Potomac Greens development.

In addition to the structures represented in the stormwater collection system geodatabase, the Potomac River drainage network includes a few open channels or ditches to convey storm flows to the Potomac River. Natural drainage within the watershed are limited to wetlands and undeveloped space around the George Washington Parkway. These open drainage channels are represented separately in the City's geodatabase in a stream feature class but are not included in the capacity analysis. Three small ditches that complete hydraulic connectivity are included in the hydraulic model, but not in the geodatabase.

Public/Private and Disconnected Drainage Systems

The City's geodatabase includes structures that are privately owned. Since the hydraulic analyses and identification of capacity deficiencies include only the public facilities as per direction from the City, the structures located in privately-owned parcels were identified and excluded from the model. The methodology that was used to accomplish this is documented in the meeting minutes presented in Attachment A.

Despite survey and review of available drawings and documents, small isolated systems remained in the database. These systems were identified and removed from the model because of the lack of accurate information available to connect them to the drainage system. The disconnected systems consisted of only a few structures and did not connect to any larger downstream systems.

Modeled and Analyzed System

After reviewing and updating data in the City's geodatabase, the database was returned to the City and a copy of that geodatabase was used as the starting point for the hydraulic model. At the direction of the City, private and small disconnected systems were removed from the modeled system.

The modeled system represents an analysis of approximately 20 percent of the inlets as per the scope of work. Since drainage areas were not computed for each inlet in the model, many pipes in the model were upstream of runoff inputs and did not receive any flow. Therefore, approximately 736 pipes with diameter ranging from 8 to 24 inches and 12 pipes with diameter 30 to 48 inches in the upstream-most portions of the system were effectively eliminated from the hydraulic analysis. Only results pertaining to the analyzed system are included in this report. The analyzed system includes the following elements:

- 615 pipe segments representing 66,071 linear feet of gravity mains (storm sewers), or 51 percent of the total length of storm drains in the geodatabase. Pipe diameter/width varies from 10 to 96 inches.

- 654 drainage junction points:
  - 1 catch basins
  - 204 drainage inlets
  - 380 manholes
  - 23 nodes (blind connections)
  - 39 pipe inlet/outlets
  - 5 storage nodes
  - 2 control devices
- 3 trapezoidal segments (ditches)

Five separate storage facilities are included in the Potomac River xpswmm model: the Dry Pond P-1 (000014PD), Wet Pond P-2 (included as 000016PD-N and 000016PD-S), and Wet Pond P-3, as well as an underground storage facility in the northeastern corner of Montgomery Park. All four of the ponds are included in the model as storage nodes with stepwise linear storage functions based on contour data from as-built drawings of Potomac Yards developments. Outlet control is based on the same drawings, which provide the elevation and length of high flow and low flow weirs and orifices. Wet Pond P-2 was constructed in two separate phases, originally consisting of a rectangular pond behind the Target shopping center with the later addition of a triangular shaped wet pond that was hydraulically connected with a large diameter pipe. The final configuration includes two separate ponds, north and south, with two separate outlet controls. The north pond is the original rectangular wet pond that receives flow from the shopping center. The south pond, which was more recently completed, receives flow from the Potomac Yards development between East Glebe Road and Watson Street. Both P-2 ponds discharge to the 72 inch line adjacent to the rail road tracks.

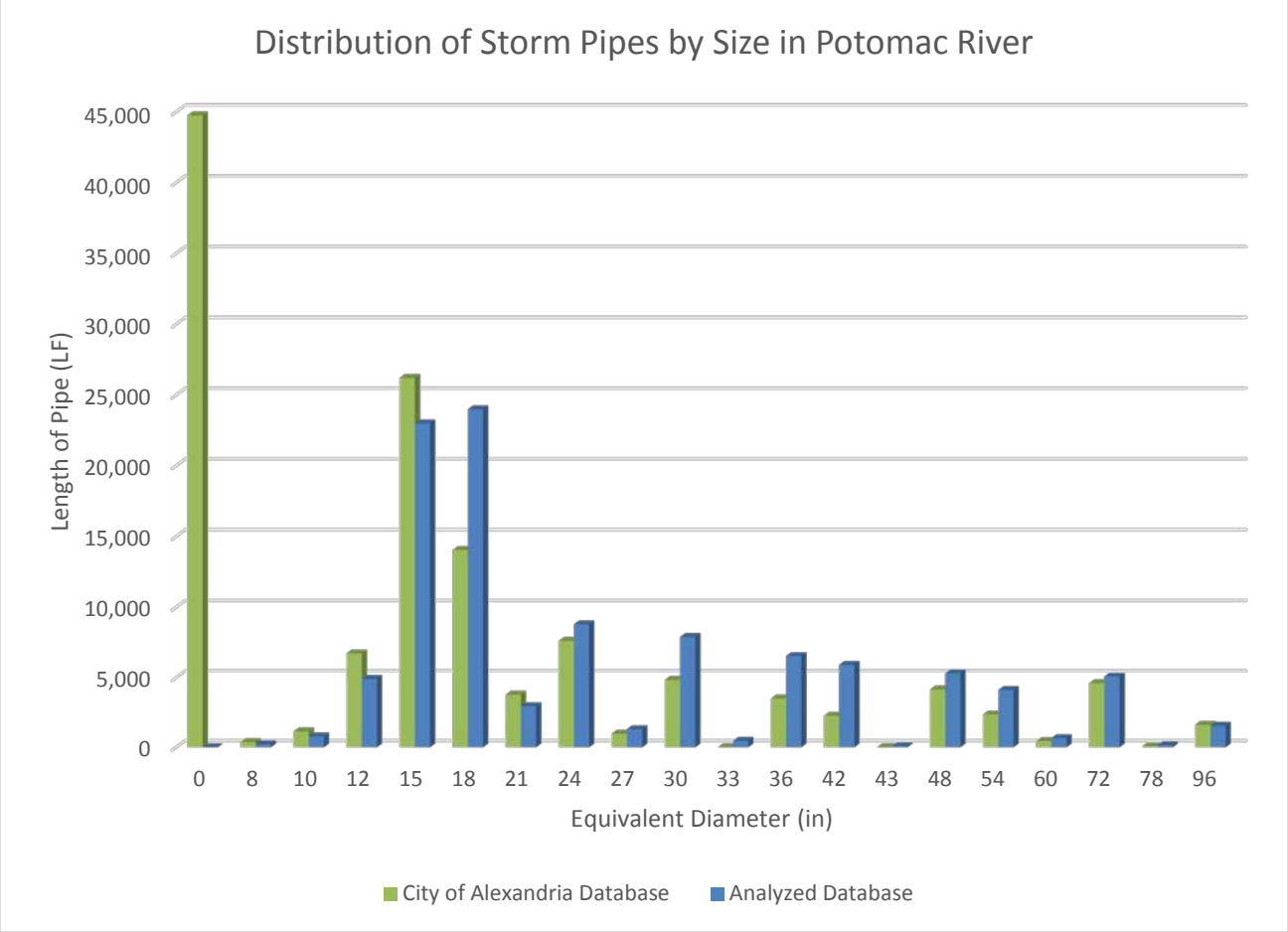
Based on field observations, the Montgomery Park facility consists of a rectangular concrete storage vault that discharges to a 10 inch pipe. The vault, which is partially exposed and visible above ground, was field measured as 12 feet wide by 48 feet long. The depth to invert was also measured and compared against information available in the geodatabase. The City's geodatabase included a 27 inch pipe that is assumed to flow into the storage vault and a field confirmed 10 inch pipe that discharges the storage vault. This information was used to add a storage node to the xpswmm model as a constant area storage node with 576 square feet of storage area (based on external length and width field measurements) and storage depth based on available information in the geodatabase. The 10 inch discharge pipe was converted to a 10 inch orifice in the model. Because of the limited amount of survey information available for this storage chamber, it is recommended that more detailed invert and diameter measurements be taken and the model updated before any projects are completed in this area.

Figure 2 shows a map of the existing stormwater collections system in the Potomac River watershed.

FIGURE 2
Existing Stormwater Collection System, Potomac River Watershed, City of Alexandria, Virginia
City of Alexandria Storm Sewer Capacity Analysis – Potomac River

The distribution by size of storm drains in the City's Potomac River geodatabase and the storm drains analyzed in the Potomac River model are presented in Figure 3. It is worth noting that approximately 41,700 linear feet (about 40 percent of total system) of new pipes were identified from plan drawings in the Potomac Yards area. These pipes were added to the City's geodatabase, but diameter and invert information available on the plan drawings were not transferred into the City's database because of the level of accuracy of the site plans compared to as-builts. This is why the City's geodatabase has such a large quantity of pipes without diameter information compared to the analyzed database, as shown in Figure 3.

FIGURE 3
Distribution of Storm Drains by Size, Potomac River Watershed, City of Alexandria, Virginia
City of Alexandria Storm Sewer Capacity Analysis – Potomac River



Data Gaps

The available data for the storm drains in the Potomac River watershed were evaluated for data quality and completeness. The City's database was updated with data collected from the field survey. However, the field survey included only storm sewer structures connected to pipes with diameter 24 inches or greater (about 70 percent of the modeled system by length, which does not include private or disconnected structures). Approximately 30 percent of the modeled system (by length) consists of sewers smaller than 24 inches in diameter and was not surveyed as part of this study. Existing data in the City's most current database were used for modeling the portions of system that were not surveyed.

Some structures in the City's most current database are missing data that are critical for modeling storm sewer systems. Examples of data gaps include missing junction rim and/or invert elevation and pipe size and inverts. A typical missing pipe invert occurs at a location with a blind pipe connection where there is no access manhole, including junction rim and/or invert elevation and pipe size and upstream and/or

downstream invert. The data gaps needed to be filled to develop a complete hydraulic model. The following standard approaches were adopted to fill the missing data:

- Missing data were inferred from the available data, if applicable. For example, a missing pipe size was assumed to equal the downstream pipe diameter.
- Pipe diameters at the most-upstream inlets were assumed to be 12 inches.
- A 6 inch depth to crown was assumed for the most upstream inlets and DNodes.
- Interior point feature invert elevations were estimated by assuming that pipe slope is constant.
- At outfalls and some blind connections to upstream private systems, the slope from the next upstream or downstream pipe was used to extrapolate an invert for the outfall or blind connection.
- Limited data available in the Geographic Information System (GIS) for ponds and the outlet control structures were supplemented with data from as-built plans.

In addition to filling in missing data, the data were reviewed for data quality and validity. Assumptions were made when the available data were not reasonable (for example, a pipe crown was above the rim of a manhole). Additional information regarding the types of assumptions made to complete the hydraulic model are provided in the *Summary of Data Gaps and Assumptions in the Hooffs Run Watershed* TM (CH2M HILL, 2012b), which was provided to the City in October 2012. The same approaches were applied to fill data gaps and resolve unreasonable data in the GIS data for the Potomac River watershed, except where field survey data are available.

Modeling Approach

The Potomac River watershed was analyzed using commercially available and public domain computer models that are industry accepted and widely used. The public domain software ArcHydro Tools for ArcGIS 10.2 (version 10.2) was used to aid delineation of catchments and to estimate hydrologic parameters, such as catchment drainage area, slope, and longest flow path. Other hydrologic parameters, such as catchment width and percent impervious, were estimated in ArcGIS after completing the catchment delineation. The private domain software xpswmm (version 2014, service pack 1) was used to simulate rainfall-runoff processes and the performance of the stormwater collection system. The xpswmm software is widely used and industry-accepted commercial stormwater management software. The core xpswmm simulation engine is based on the U.S. Environmental Protection Agency (USEPA) stormwater management model (SWMM) engine.

The City provided the following required data:

- Alexandria_Dsewer_CH2MHill_032114.gdb, a checked-out copy of the city-wide geodatabase of the stormwater collection system, which included the Potomac River watershed
- Spring 2011 DVD, City GIS data (geodatabase and orthophotography) such as topographic data and land use
- Spring 2013 DVD, City GIS data (geodatabase and orthophotography) such as topographic data and land use

Hydrologic Modeling

The hydrologic modeling required two major types of inputs:

- **Hydrologic parameters:** Delineation of catchments and computation of hydrologic parameters such as drainage area, slope, width, and percent impervious for each catchment.
- **Design Hyetographs** - Development of a 24-hour synthetic rainfall distribution for the 10-year design storm event

Hydrologic Parameters

Hydrologic parameters were estimated using ArcHydro and Hydrologic Engineering Center (HEC)-GeoHMS.

The ArcHydro tools are a set of public domain utilities developed jointly by the Center for Research in Water Resources of the University of Texas at Austin (http://www.crwr.utexas.edu), and the Environmental Systems Research Institute. These tools provide functionalities for terrain processing, watershed delineation, and attribute management. They operate on top of the ArcHydro data model in the ArcGIS environment. The model uses a digital elevation model (DEM) of the subject watershed to compute hydrologic parameters. The "burning in" technique allows the user to impose the drainage system on the terrain to better produce the catchment boundaries.

HEC-GeoHMS is geospatial hydrologic modeling software developed and maintained by the HEC of the U.S. Army Corps of Engineers (USACE). The model allows users to visualize spatial information, perform spatial analysis, delineate subbasins, and estimate watershed hydrologic parameters (USACE, 2003).

In this study, 2-foot contour data provided by the City were used to create a DEM of the watershed and vicinity. ArcHydro tools were used to delineate the catchments (also referenced as subbasins in the tools). Because of the recent development in the Potomac Yards area, 2 foot contours from the Spring 2013 DVD were used to create an updated DEM. This replaces the DEM that had been created from 2011 contours and used for all other watershed included in this project. HEC-GeoHMS was used to compute hydrologic parameters, such as drainage area, slope, and longest flow path for each catchment. Width was derived using the catchment drainage area and longest flow path using the equation: width = (area/longest flow path). Percent impervious was estimated in ArcGIS using the delineated catchments and impervious coverage shapefiles provided by the City.

Updated subwatershed and watershed boundaries were developed using the catchment layer developed during the modeling process and returned to the City. Schematics of the hydrologic model for each subwatershed are presented in Attachment B. The schematics show the catchment identification, delineated boundaries, and longest flow path for each catchment as well as the DEM of the Potomac River watershed. The hydrologic parameters for each subwatershed are also presented in Attachment B. The following are the major drainage characteristics for the Potomac River watershed, based on the hydrologic model:

- Total drainage area is 1.3 square miles or 835 acres, 485 of which was included in the model[1]
- Modeled drainage area divided into 8 subwatersheds containing 194 catchments[2]
- 60 percent of the modeled drainage area is impervious
- Average modeled catchment area is 2.5 acres
- Average modeled catchment slope is 0.02 feet/feet
- Average modeled catchment width is 169 feet

Design Hyetograph

The 24-hour synthetic rainfall distribution for the 10-year design storm event was developed based on rainfall data from the existing intensity-duration-frequency (IDF) curve for the 10-year return period for Alexandria (City of Alexandria, 1989). Time of concentration values were computed for several inlets in the Hooffs Run pilot subwatershed and the Four Mile Run priority subwatershed. Based on these results, the peak rainfall intensity was selected from the IDF curve, based on a 15-minute time of concentration. A variable time interval approach was used to generate the design hyetograph. The design hyetograph was developed to yield maximum rainfall intensity at the approximate center of the 24-hour storm. The 24-hour

[1] All land area around the George Washington Parkway and along the Potomac River waterfront that drains directly to the Potomac River was excluded from the model.

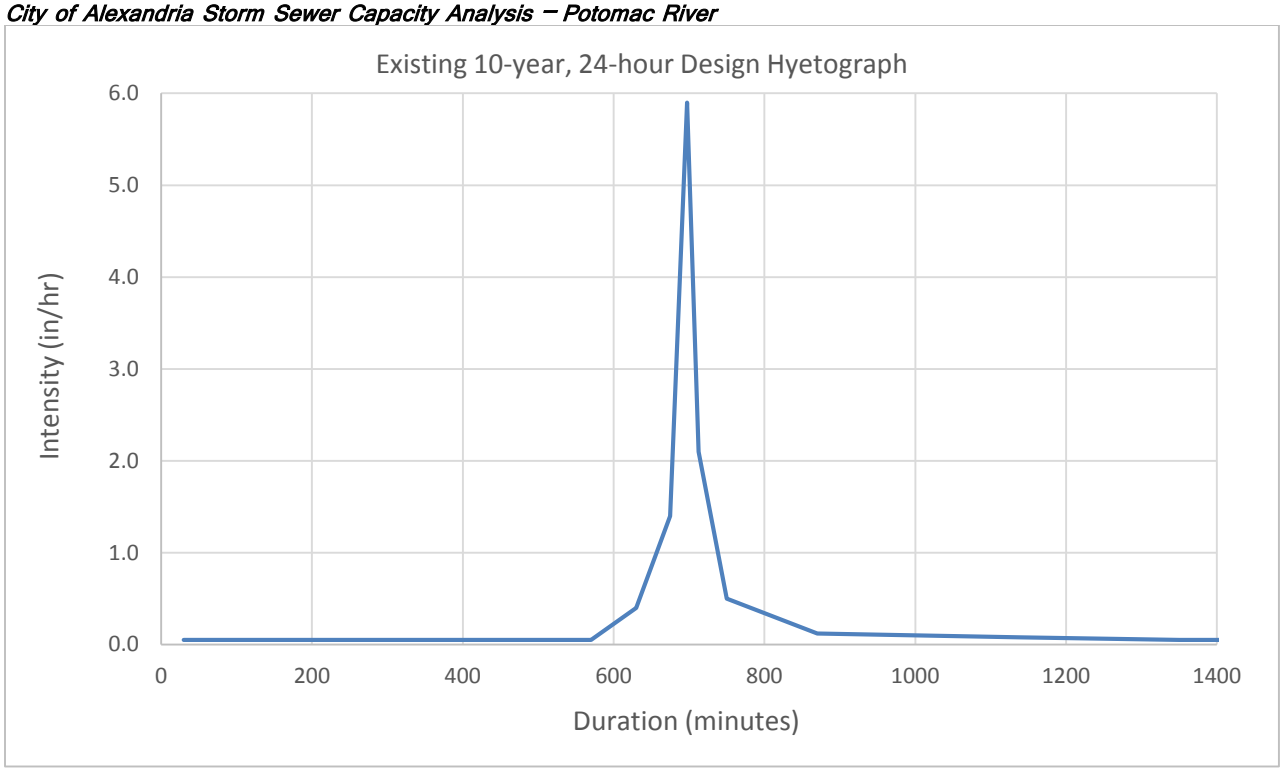
[2] Area not included in the hydrologic model was merged into a single catchment. This area is shown as subwatershed 0 in maps.

rainfall total is 5.04 inches, and the peak intensity is 5.9 inches per hour (in/hr). Table 1 and Figure 4 present the existing 10-year, 24-hour design hyetograph.

TABLE 1
Existing 10-year 24-hour Design Hyetograph Data
City of Alexandria Storm Sewer Capacity Analysis – Potomac River

Start Time (minutes)	Duration (minutes)	Absolute Rainfall Depth (inches)	Intensity (in/hr)
0	60	0.05	0.05
60	60	0.05	0.05
120	60	0.05	0.05
180	60	0.05	0.05
240	60	0.05	0.05
300	60	0.05	0.05
360	60	0.05	0.05
420	60	0.05	0.05
480	60	0.05	0.05
540	60	0.05	0.05
600	60	0.40	0.40
660	30	0.70	1.40
690	15	1.475	5.90
705	15	0.525	2.10
720	60	0.50	0.50
780	180	0.36	0.12
960	360	0.48	0.08
1320	60	0.05	0.05
1380	60	0.05	0.05

FIGURE 4
Existing 10-Year 24-Hour Design Hyetograph
City of Alexandria Storm Sewer Capacity Analysis – Potomac River



Simulation of Stormwater Runoff

The xpswmm 2014 software was used to simulate rainfall-runoff processes from the Potomac River watershed. The hydrologic parameters such as area, slope, width, and percent impervious for the 194 catchments listed in Attachment B were estimated using ArcGIS, ArcHydro Tools 10.2, as described in the previous section. These hydrologic parameters and the 10-year, 24-hour design hyetograph were used as input to the RUNOFF module of the xpswmm model. The USEPA SWMM Runoff Non-linear Reservoir Method was used to simulate the stormwater runoff from each catchment in response to the hyetograph.

Hydraulic Modeling

The xpswmm model was used to simulate the hydraulic performance of the stormwater collection system during a 10-year, 24-hour design storm event. Model input data included the following physical data:

- Junction (such as, inlet, manhole, and nodes) invert and rim elevations
- Closed and open conduit invert elevations, size, shape, material, and length
- Stormwater storage pond stage-storage relationships
- Control device (such as, orifices and weirs) size, shape, and length

The data for the stormwater collection system were primarily imported into the model from the geodatabase provided by the City. This geodatabase was updated with survey data for structures that are attached to pipes that are 24 inches or larger in diameter and considered public. Private structures were not modeled, so any private runoff was applied to the next downstream model load point. All elevations (invert and rim) recorded in the geodatabase of the stormwater collection system are in North American Vertical Datum of 1988 (NAVD88) datum; therefore, the xpswmm model was built in NAVD88.

Entrance or exit loss coefficients were applied to pipes at connections where pipe size significantly increased or decreased. An exit loss coefficient of 0.15 was applied to the smaller (upstream) pipe where the downstream pipe was two or more times the size of the upstream pipe or the downstream pipe shape is different. An entrance loss coefficient of 0.1 was applied to the smaller (downstream) pipe where the downstream pipe was half the size, or smaller, of the upstream pipe.

The Potomac River watershed predominantly discharges directly to the Potomac River or Four Mile Run; however, the hydraulic model does not extend beyond the storm sewer outfalls to the channel. The system was modeled as a series of smaller disconnected systems with 21 separate outfalls, which include:

- 16 outfalls to the Potomac River or short tributaries directly connected to the main channel
- 1 outfall to Four Mile Run between Potomac Avenue and the George Washington Parkway
- 4 outfalls to wetlands adjacent to the George Washington Parkway between Marina Drive and Slaters Lane

Depending on the location, outfalls were either assumed a free outfalls or a tidal control boundary condition was included. A list of outfalls and corresponding boundary conditions is available in Attachment D. For those outfalls that are influenced by tidal fluctuations, a typical existing tidal condition was computed, averaging 6 months of tidal data (February to July 2012) from the Hains Point tidal gauge (station 8594900) in the Potomac River (elevations in NAVD88):

- Mean higher high water = 2.02
- Mean high water = 1.83
- Mean low water = -0.96
- Mean Lower Low Water = -1.15

There are three ditches in the Potomac River watershed that are included in the model. These small reaches were added to the model as trapezoidal channels to complete the hydraulic connectivity of the storm

drainage system. A standard trapezoidal cross section was assumed for the two ditches higher up in the storm system network and therefore less significant to the overall network. One of the open channel segments is on the western edge of the Potomac Greens development where an 18 inch by 30 inch elliptical pipe daylights into a 12 feet long channel before transitioning into a 42 inch pipe. A trapezoidal cross section was developed for this open channel based on survey data, incoming and outgoing pipe size, and engineering judgement. Length, slope, and Manning's roughness, *n* values were estimated using aerial photos and contour data for all three ditches.

The primary objective of the hydraulic modeling was to analyze pipe capacities. Hydrographs from the RUNOFF module were entered directly into the underground storm sewer system. This approach does not model the flow restrictions caused by the surface inlets and provides a conservative or "worst case" evaluation of pipe capacities. Because of modeling software and data limitations, inlet capacity cannot be readily modeled in xpswmm and is instead being evaluated in a separate spreadsheet. The details of the model limitations encountered during this study and the external spreadsheet evaluation are provided in *Inlet Capacity Analysis for City of Alexandria Storm Sewer Capacity Analysis* (CH2M HILL, 2012a).

Model Results

Model results are summarized in the following sections.

Hydrologic Model Results

Peak discharge for each node where overland flow was loaded into the hydraulic model is provided in Attachment C.

Inlet Capacity Results

Inlet capacity was evaluated outside xpswmm because of limitations in the modeling software's capabilities. Details on the evaluation of the options for modeling inlet capacity are provided in *Inlet Capacity Analysis for City of Alexandria Storm Sewer Capacity Analysis* (CH2M HILL, 2012a), which was provided to the City in September 2012. The spreadsheet evaluation multiplies the maximum capacity of a single inlet, estimated to be 3.25 cubic feet per second, based on an assumed standard gutter spread and road cross-section, by the total number of catch basins and inlets draining to a single runoff input point, the location where overland flow was plugged into the hydraulic model. The model has flow loaded into 193 locations with an average of 5 inlets per runoff input point. The estimated capacity for each load point was compared to the peak runoff generated in the RUNOFF module of xpswmm to determine whether the catchment has sufficient inlet capacity. Results suggest that about 26 percent or 51 of 193 model load points may be experiencing inlet capacity deficiencies.

The total inlets and catch basins count is based on the City's GIS data for Potomac River watershed, including all private and disconnected inlets and catch basins. The City's GIS data does not include all private structures in the Potomac River watershed since they are not always included in survey efforts. This effectively underestimates the City's available inlet capacity in this analysis. Inlet capacity results are presented in detail in Attachment C.

Hydraulic Model Results

Model results for the pipes are summarized in the following sections. Detailed results are presented in Attachment D.

Pipe Capacity

The conveyance capacity of the existing stormwater collection system during the 10-year, 24-hour storm event was evaluated based on three criteria, listed in order of decreasing severity:

- If the hydraulic grade line (HGL) rose above the ground surface, the structure was considered flooded.

- If the HGL rose to within 2 feet of the ground surface, the structure was considered to have insufficient freeboard.
- If the HGL rose above the crown of the pipe but was more than 2 feet from the ground surface, the structure was considered surcharged.

Pipes were evaluated for these conditions at the upstream end. In some cases the water surface was within 2 feet of the ground surface, but within the pipe (not surcharging), because the crown of the pipe was less than 2 feet from the ground surface. In those cases, the pipes were not included in the "insufficient freeboard" category.

Additional details on the results are presented in the following section. The pipes with flooded, insufficient freeboard and surcharged conditions are summarized in Tables 2 and 3. Figure 5 shows the location of pipes experiencing flooding, insufficient freeboard, and surcharged conditions in Potomac River watershed. Profiles of pipes displaying conditions of the pipes along the main storm sewer line within the Potomac River watershed are provided in Attachment D. The profiles display:

- Vertical cross-sectional view of the conduits, including the inverts and crowns. They also illustrate the flow conditions such as partially full, full, or surcharged.
- Water surface elevation in the conduit (that is, HGL)
- HGL in junctions such as manholes, inlets, and nodes
- HGL above the conduit crown (surcharged conditions)
- HGL above the ground (flooding)

Note that the profiles presented only show a snapshot of the system during the model simulation. These profiles will not always show the most severe flooding at each location. For example, the profile may not show the flooding symbol at a location even though surface flooding may occur either before or after the snapshot of the profile was taken.

The detailed model results are presented in tabular format in Attachment D. The results presented in this TM should be reviewed with the understanding that flow data were not available for model calibration, and several assumptions were made to fill data gaps, primarily, assumptions about pipe inverts where survey data were unavailable.

The model results presented in Table 2 show that 9 percent of the pipes flood the ground surface, 8 percent have a hydraulic grade line within 2 feet of the surface, and 13 percent surcharge above the crown of the pipe. Potomac River model results show relatively little flooding compared with other watersheds that were modeled as part of this study. The distribution of pipe (linear footage) by diameter in the Potomac River watershed shows that about 50 percent of the total length of pipe modeled are 30 inches or larger, compared with only approximately 20 percent in the majority of the other watersheds modeled as part of this study.

The Potomac Yards area, which is newly developed makes up almost half of the watershed. The collection system in the newly developed area should be expected to meet current design standards. The model does not show any significant capacity limitation in this area of the watershed with the exception of some surcharging in the 72 inch line that runs parallel to the railroad tracks. There are several additional BMPs, including sand filters and Bay Separators that, in reality, could be potentially eliminating any surcharging in this line. However, these BMPs were not included in the model because of limited information on their configuration.

The model results primarily predicted flooding and other capacity limitations in Old Town Alexandria areas of the watershed. The conservative nature of the model, which assumes a coincident peak rainfall and high tide, appears to be a major contributing factor to the flooding predicted by the model. The systems directly

connected to the Potomac River tend to have outfall inverts well below (6 inches to 8 feet) Mean Higher High Water. Because these systems are also small and only extend 2 or 3 city blocks inland from the Potomac River, tidal backwater can extend up into the system, preventing storm runoff from flowing through the pipes during the peak of the rainfall event. Rising sea level could exacerbate this issue in the future.

Flooding is predicted in the area downstream of the detention chamber identified in Montgomery Park. Although the storage vault was included in the model based on field observations, limited information was available on the outlet control; therefore, a detailed survey of the storage facility, outlet control, and pipe sizes upstream and downstream of this area should be completed before any drainage projects are initiated in this area. A profile of the pipes upstream and downstream of this storage facility are included in Attachment D, Profile 20.

TABLE 2

Watershed Modeling Results, Summarized by Pipe Size

City of Alexandria Storm Sewer Capacity Analysis – Potomac River

	Sufficient Capacity			Surcharged			Insufficient Freeboard			Flooded		
Equivalent Pipe Diameter (ft)	**Count**	**Length (LF)**	**Percent of Total Length**	**Count**	**Length (LF)**	**Percent of Total Length**	**Count**	**Length (LF)**	**Percent of Total Length**	**Count**	**Length (LF)**	**Percent of Total Length**
Less than 2.0	88	8,453	13%	45	4,176	6%	33	3,171	5%	64	5,038	8%
2.0 to 2.75	143	12,911	20%	19	1,152	2%	14	1,098	2%	6	648	1%
3.0 to 4.9	148	20,090	30%	16	1,805	3%	0	0	0%	0	0	0%
5.0 and above	27	4,607	7%	7	1,487	2%	5	1,420	2%	0	0	0%
Total	**406**	**46,062**	**70%**	**87**	**8,621**	**13%**	**52**	**5,690**	**9%**	**70**	**5,686**	**9%**

Note: Table does not include pipes upstream of hydrologic load points in the model
Results are based on results at upstream end of pipe
ft = feet
LF = linear feet

TABLE 3

Watershed Model Results, Summary by Capacity

City of Alexandria Storm Sewer Capacity Analysis – Potomac River

Capacity	**Conduit Count**	**Conduit Length (LF)**	**Percent of Total Length**	**Duration (hr)**				**Volume (ft^3)[a]**			
				Max.	**Min.**	**Avg.**	**Total**	**Max.**	**Min.**	**Avg.**	**Total**
Sufficient Capacity	406	46,062	70%	-	-	-	-	-	-	-	-
Surcharged[b]	87	8,621	13%	72.0	0.1	7.5	1,430	-	-	-	-
Insufficient Freeboard	52	5,690	9%	-	-	-	-	-	-	-	-
Flooded	70	5,686	9%	5.4	0.0	1.2	82	37,248	8.50	3,853	269,742

Notes: All results presented for pipe segments based on capacity at upstream end of pipe.

[a] Flooded volume

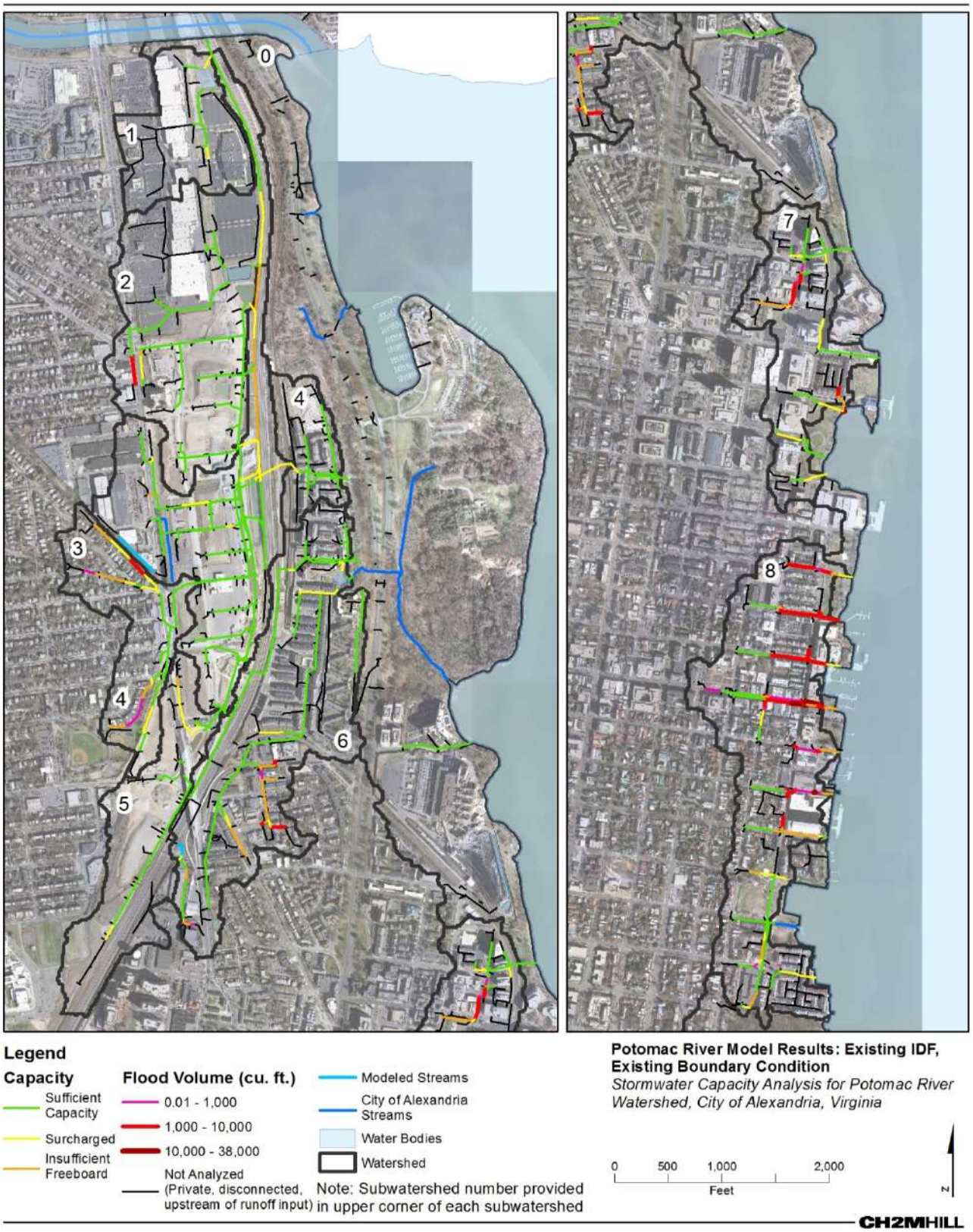
[b] Duration of surcharged flow includes time during which conduits have insufficient freeboard or are flooded at the upstream end.

ft^3 = cubic feet
hr = hour
LF = linear feet

FIGURE 5

Potomac River Model Results – 10-Year, 24-Hour Based on Existing IDF Curve

City of Alexandria Storm Sewer Capacity Analysis – Potomac River



Open Channel Results

The hydraulic model does not contain any stream channels with defined cross sections; therefore, no results are presented in this section of the report.

Summary

The hydraulic model predicts that about 30 percent of the Potomac River watershed is experiencing capacity-related deficiencies during the 10-year, 24-hour design storm. The model results show that 9 percent of the pipes flood the ground surface, 9 percent have a hydraulic grade line within 2 feet of the surface, and 13 percent surcharge above the crown of the pipe. Comparing the peak runoff to the estimated inlet capacity of each catchment indicates that 26 percent of the catchments in the model may have insufficient inlet capacity. Flooding is predicted primarily in Old Town Alexandria, near the waterfront and in older developments around Potomac Yards. Maps and profiles of flooding areas are presented in Attachment D of this TM to assist in locating problem areas and understanding the capacity deficiencies of the drainage system.

While the focus of this study is on drainage issues associated with drainage conveyance systems in the City of Alexandria that are designed for the 10-year storm, the City recognizes that flooding can also result from flood crest elevations in the surrounding rivers, which result from larger storms and/or storm surge events and have much longer response times to rainfall. The City has embarked on a flood mitigation study for the Potomac River waterfront, referred to as the Potomac River Waterfront Flood Mitigation Study (URS, 2010), which is based on the Alexandria Waterfront Small Area Plan, completed by the Department of Planning and Zoning in 2012. Schematic designs developed as a part of the Waterfront Flood Mitigation Project (URS, 2014) includes a number of elements, including a new flood wall or bulkhead, a promenade and park east of Union Street, between Queen Street in the north and Wolf Street to the south, and two new pump stations.

The hydraulic modeling results presented in this TM should be reviewed with the understanding that several assumptions were made to fill data gaps, primarily assumptions of inverts in pipes with diameter less than 24 inches.

References

These documents were consulted in the preparation of this memorandum. Not all are cited in the text.

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URS. 2014. *Waterfront Flood Mitigation Project Schematic Design*. Prepared for the City of Alexandria Department of Project implementation. July 31.

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Attachment A
Methodology for Identifying Public vs. Private Structures: August 6, 2009, Meeting Summary

City of Alexandria Storm Sewer Capacity Analysis Project – Task Order 1

Meeting, August 6, 2009 (2:30-3:00 pm)

ATTENDEES:

Craig Perl/City of Alexandria
Laurens van der Tak/CH2M HILL
Cheri Salas/ CH2M HILL

FROM: Cheri Salas/CH2M HILL

DATE: August 7, 2009

PROJECT NUMBER: 383412

Meeting Purpose

Review memorandum dated July 31, 2009, entitled Evaluation of modeling issues discussed during July 27, 2009 Progress Meeting

- Discuss results of initial public\private structure determinations
- Review initial evaluation of survey data quality
- Discuss altered approach to filling data gaps associated with missing inlet inverts

Meeting Review

Private vs. Public Structures

It was difficult to readily identify structures as private or public, based solely on the parcel layer because of potential errors in the structure locations. The memorandum includes several examples. Several of these include individual public structures that are upstream of larger private storm sewer areas. Craig will share these with Suzanne and others to confirm a path forward. It was agreed that regardless of the path forward on future sewersheds, we would not change the model for the pilot sewershed, but will not attempt to evaluate capacity limitations in the private areas. Craig will confirm which areas in the memo examples should be evaluated.

As we move into the remainder of Hooffs Run CH2M HILL will identify large areas of private sewers based on a broad visual review of the sewersheds, CH2M HILL will recommend a starting point for the hydraulic model (pour point for hydrologic basin) and allow the City to review the recommendations prior to beginning filling data gaps or modeling.

Stormwater ponds were discussed. These are mostly, if not all, private facilities; however they should have significant impact on the peak flows in the system. It was recognized that there is significant effort associated with obtaining the data for these ponds, and adding it to

the model. The one pond in the pilot sewershed was retrofitted since the as-built plans; therefore a site visit may be required to obtain appropriate outlet dimensions.

Survey Data Quality

We do not foresee any significant data issues in the Pilot sewershed related to surveyed inverts; however it may be a bigger issue as we move into flatter sewersheds. This issue will be tabled until we move on to other sewersheds

Filling Data Gaps in Inlet Inverts

As we were filling data gaps we recommended using a 1-foot depth to invert for all inlets for which the data were not available. In approximately 15 of the 153 inlets for which invert data were not available, the pipe diameter was larger than 12-inches, resulting in model errors. A revised approach of using the pipe diameter plus 6-inches as the assumed depth to invert is recommended, however it is unclear whether this approach will be appropriate for the locations in question. CH2M HILL will provide a Google Earth Map of these inlets and Craig will review, and possibly conduct field inspections. CH2M HILL will not continue modeling of the pilot shed until results of this review are received.

Action Items

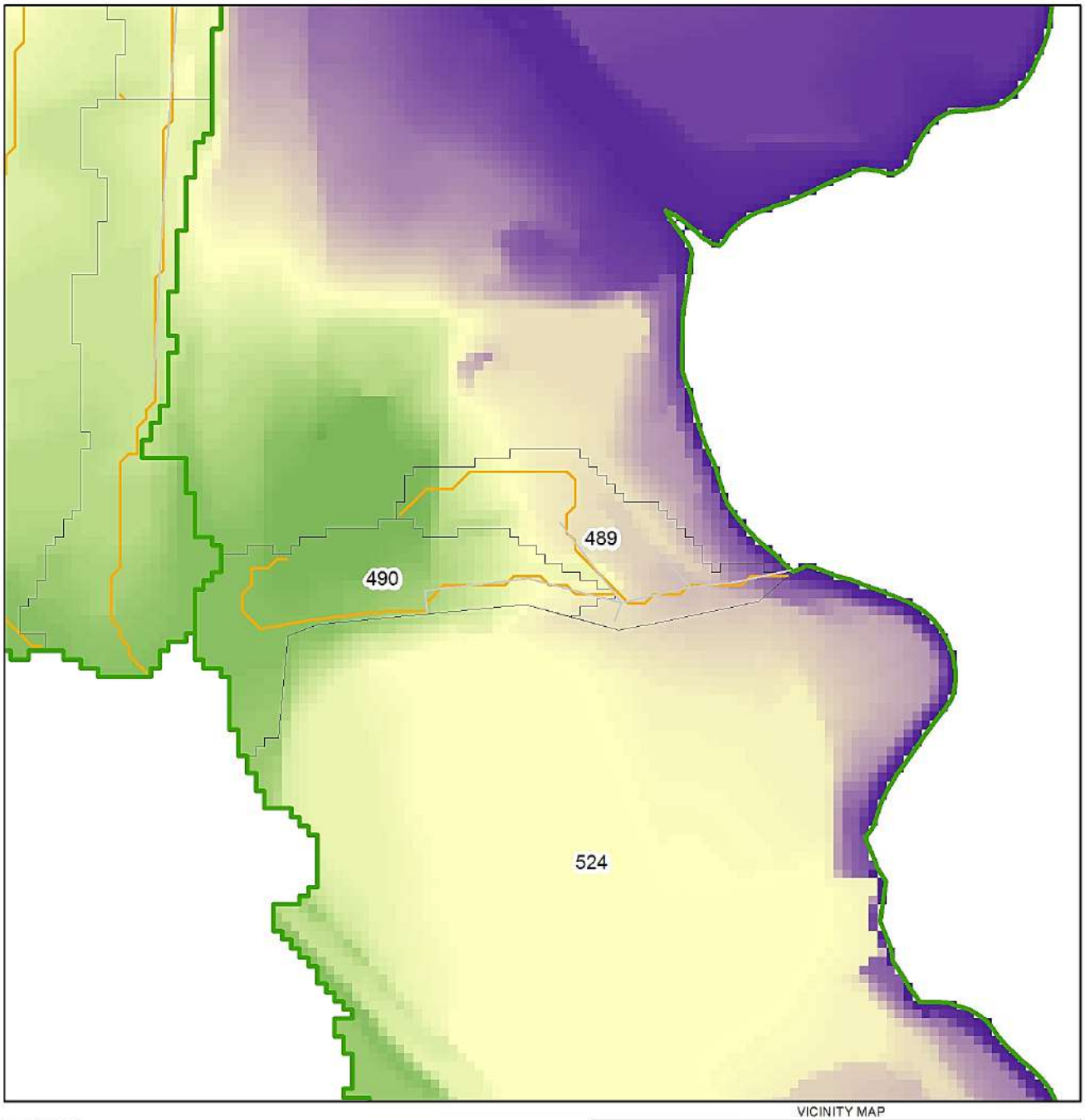
Craig will share July 31, 2009 memo with additional City staff and determine extent of capacity evaluation in pilot area. He will also confirm recommended path forward.

Craig will determine preferred approach to inclusion of stormwater ponds in the model.

Cheri will provide Google Earth maps of locations where a 1-foot depth to invert was not sufficient.

Craig will review these sites and provide input on an appropriate assumption moving forward.

Attachment B
Hydrologic Model Schematic and Parameters



LEGEND

DGravityMain

Longest Flow Path

Modeled Catchments

Subwatersheds

DEM Elevation (ft)

High : 68

Low : 0

Note: The catchment with HydroID 524 includes areas that drain directly to the Potomac River via small systems and land surrounding the George Washington Parkway and is not included in the hydrologic model.

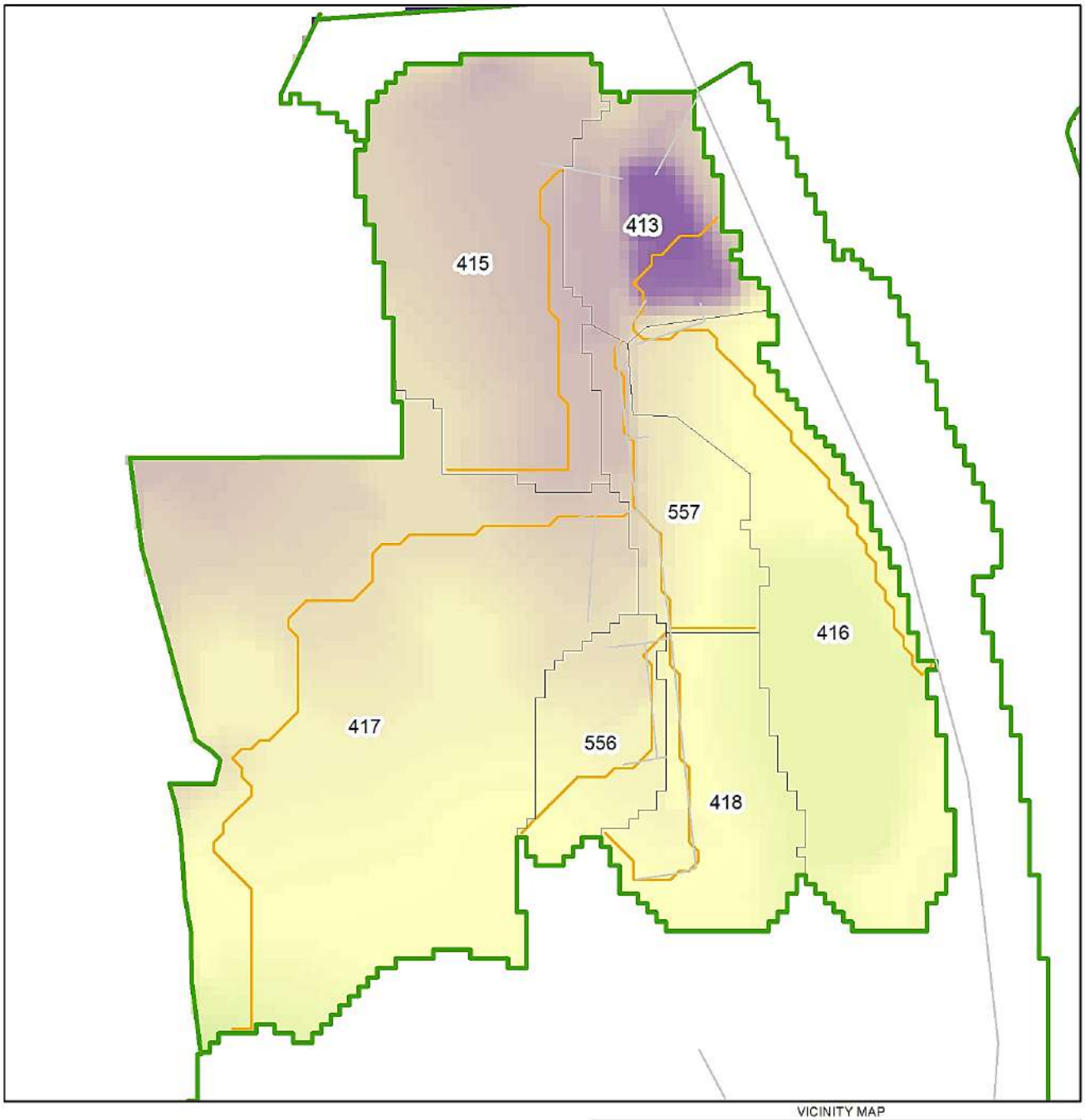
VICINITY MAP

0 250 500

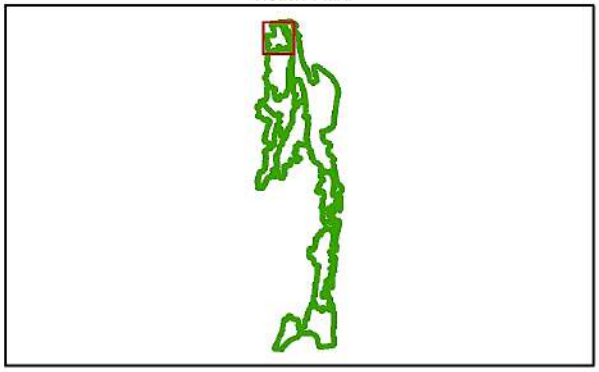
Feet

N

FIGURE 1
Potomac River Subwatershed 0 Catchments
Stormwater Capacity Analysis for Potomac River Watershed, City of Alexandria, Virginia
City of Alexandria Storm Sewer Capacity Analysis



VICINITY MAP



LEGEND

- DGravityMain
- Longest Flow Path
- Modeled Catchments
- Subwatersheds

DEM Elevation (ft)

High : 68

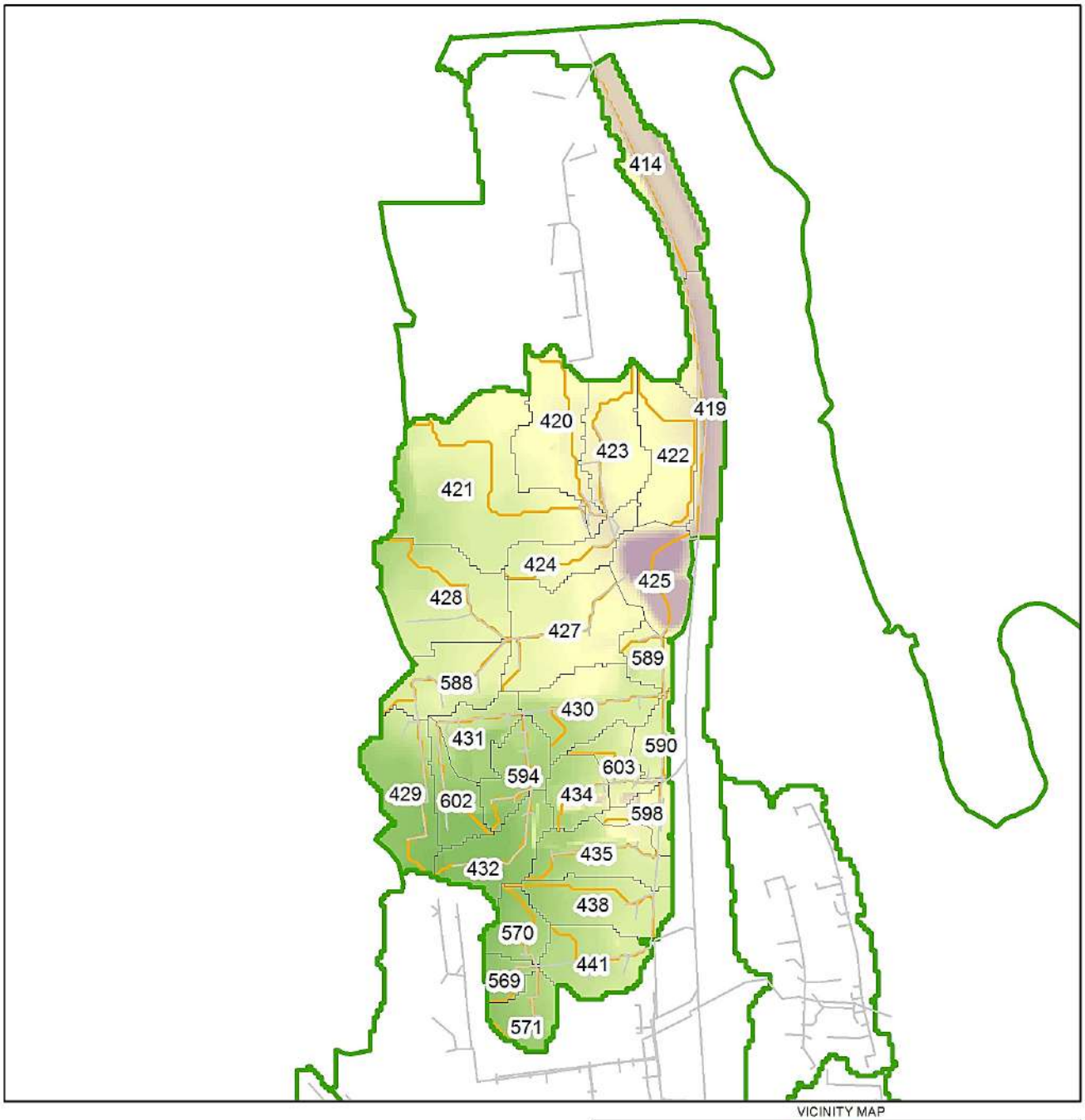
Low : 0

0 250 500

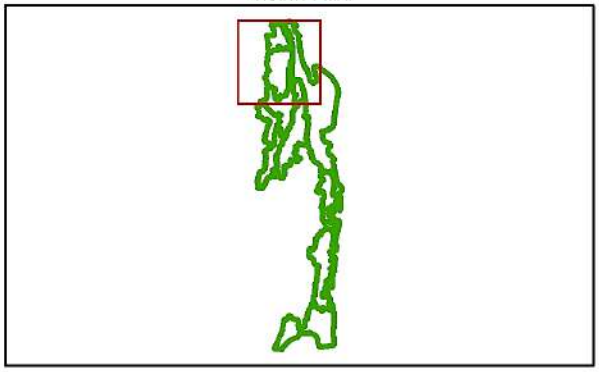
Feet

N

FIGURE 2
Potomac River Subwatershed 1 Catchments
Stormwater Capacity Analysis for Potomac River Watershed, City of Alexandria, Virginia
City of Alexandria Storm Sewer Capacity Analysis



VICINITY MAP



LEGEND

- DGravityMain
- Longest Flow Path
- Modeled Catchments
- Subwatersheds

DEM Elevation (ft)

High : 68

Low : 0

0 500 1,000

Feet

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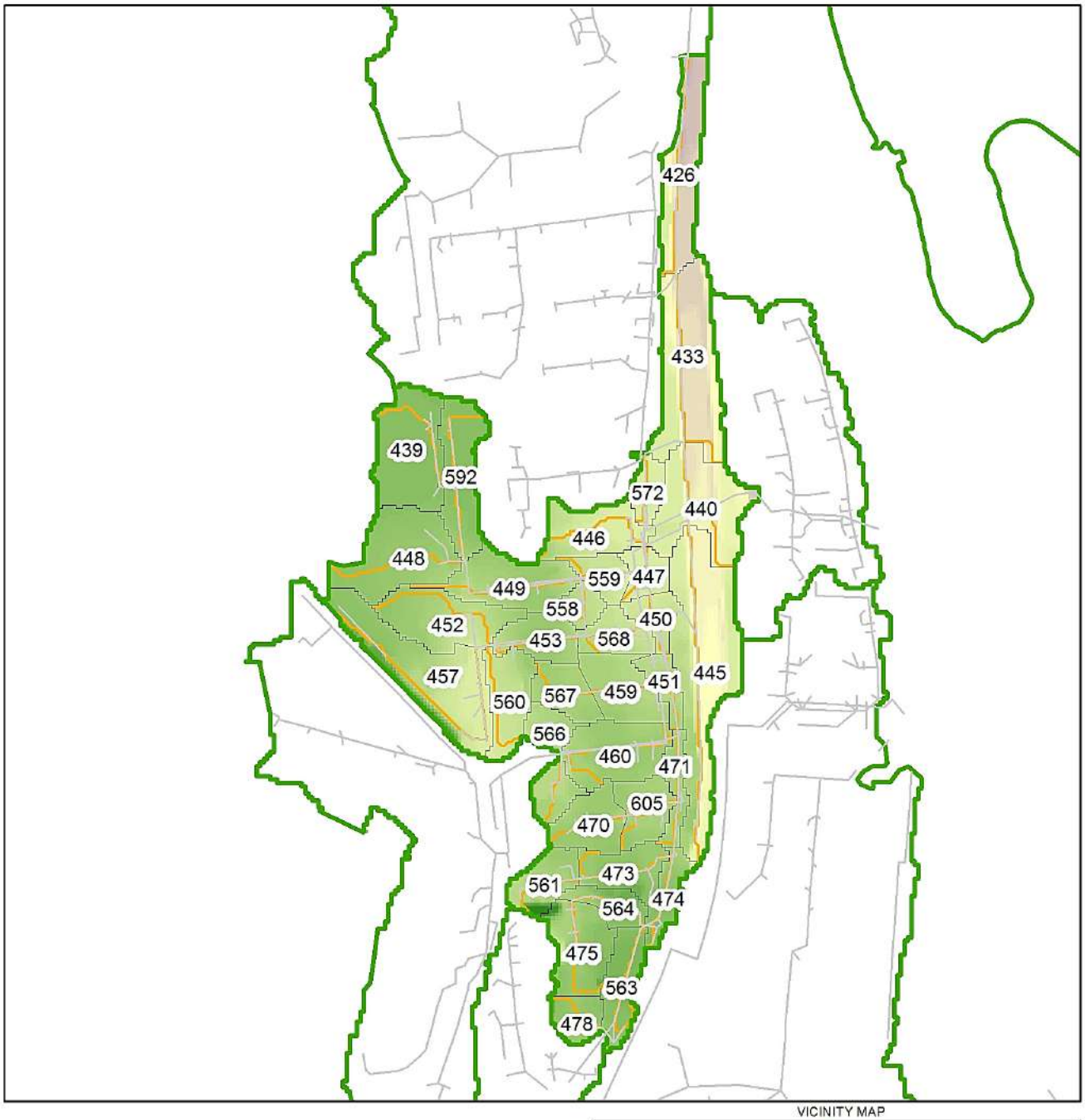
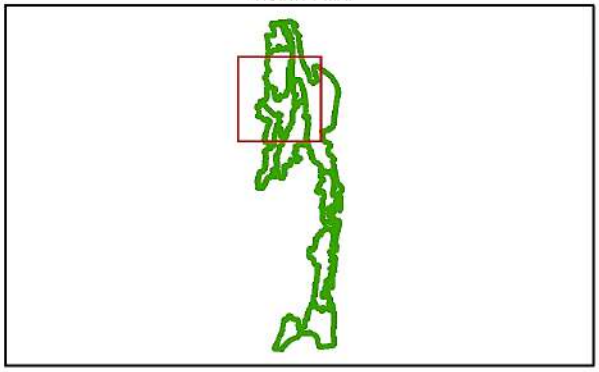
FIGURE 3
Potomac River Subwatershed 2 Catchments
Stormwater Capacity Analysis for Potomac River Watershed, City of Alexandria, Virginia
City of Alexandria Storm Sewer Capacity Analysis

CH2MHILL.



VICINITY MAP



LEGEND

- DGravityMain
- Longest Flow Path
- Modeled Catchments
- Subwatersheds

DEM Elevation (ft)

High : 68

Low : 0

0 500 1,000

Feet

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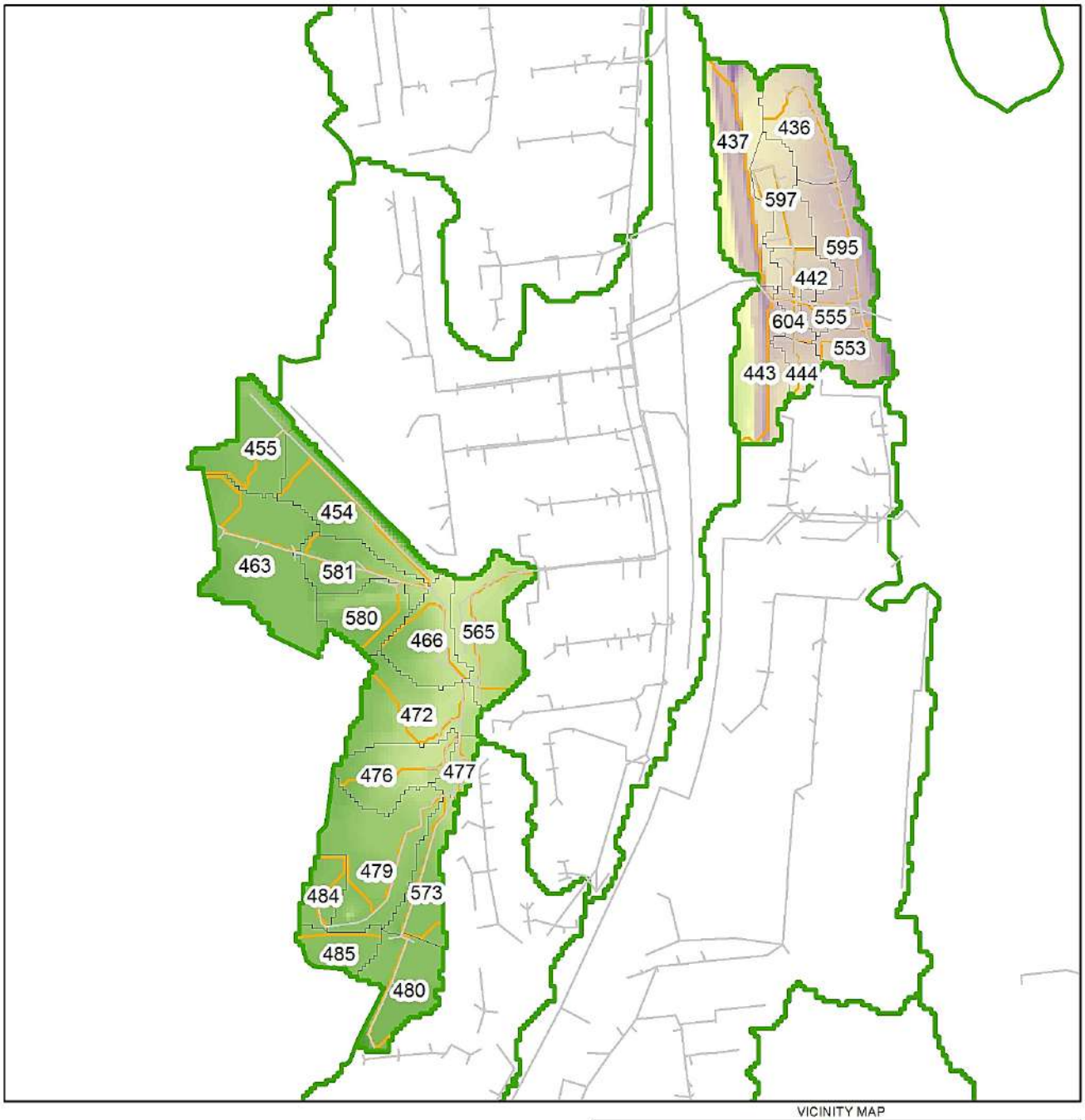
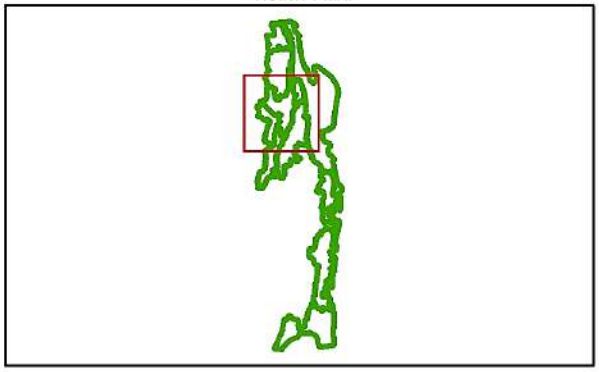
FIGURE 4
Potomac River Subwatershed 3 Catchments
Stormwater Capacity Analysis for Potomac River Watershed, City of Alexandria, Virginia
City of Alexandria Storm Sewer Capacity Analysis

CH2MHILL.



VICINITY MAP



LEGEND

- DGravityMain
- Longest Flow Path
- Modeled Catchments
- Subwatersheds

DEM Elevation (ft)

High : 68

Low : 0

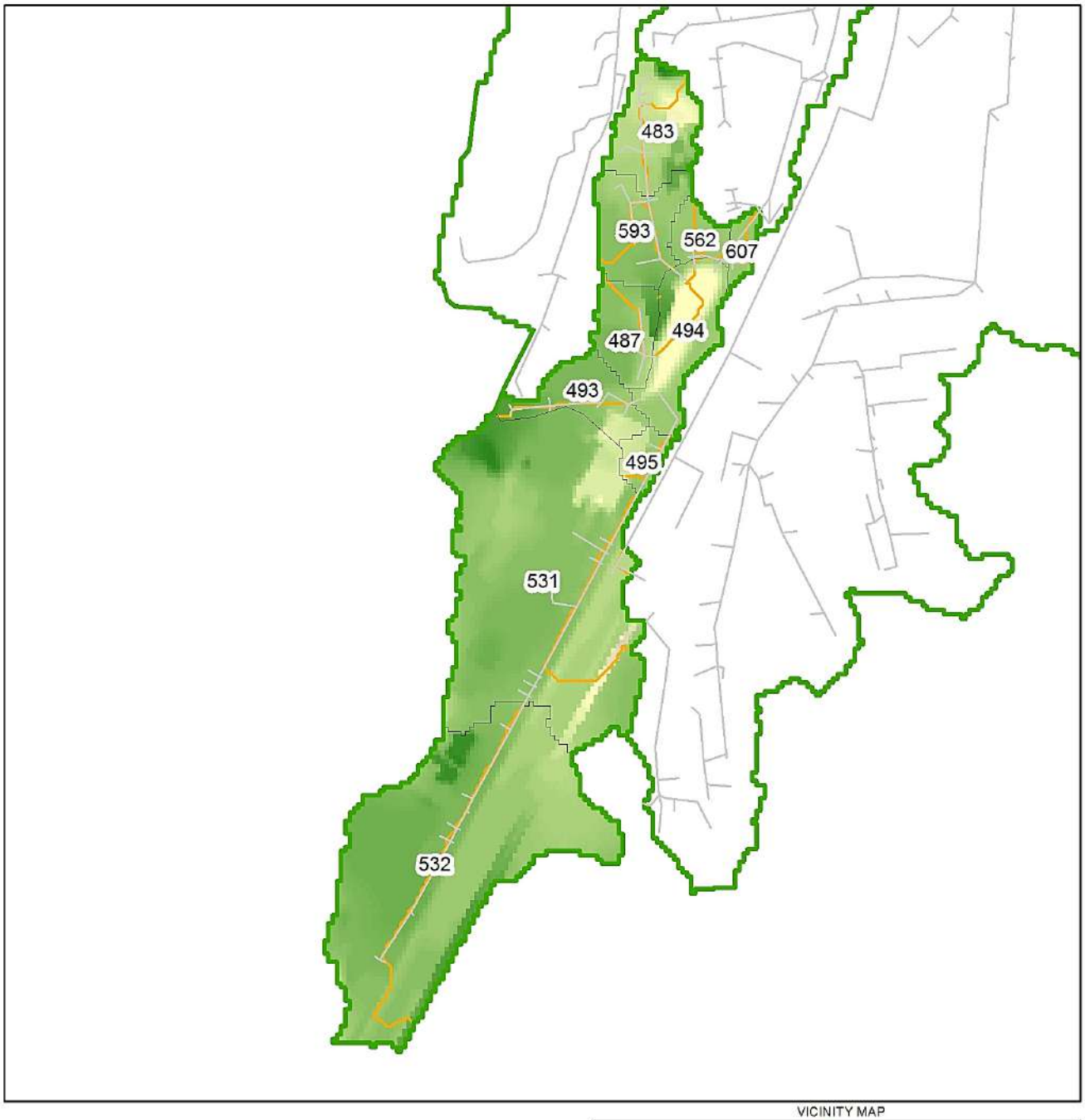
0 500 1,000

Feet

N

FIGURE 5
Potomac River Subwatershed 4 Catchments
Stormwater Capacity Analysis for Potomac River Watershed, City of Alexandria, Virginia
City of Alexandria Storm Sewer Capacity Analysis

CH2MHILL.



LEGEND

- DGravityMain
- Longest Flow Path
- Modeled Catchments
- Subwatersheds

DEM Elevation (ft)

High : 68

Low : 0

0 500 1,000

Feet

N

VICINITY MAP

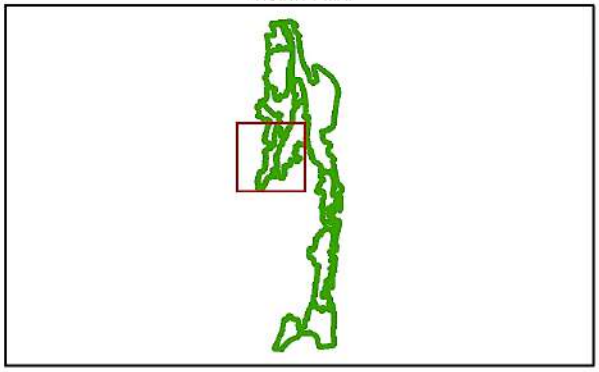
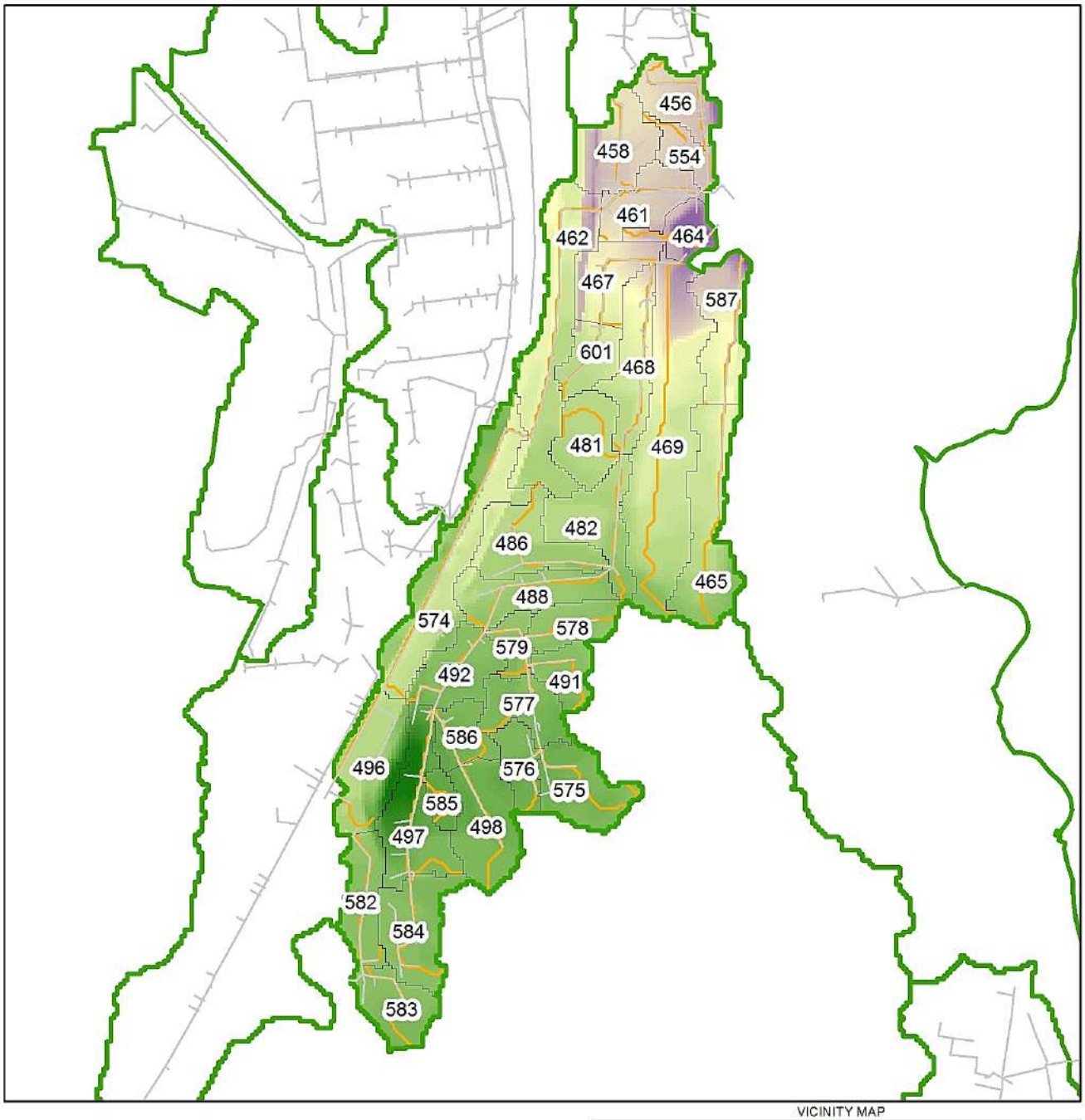


FIGURE 6
Potomac River Subwatershed 5 Catchments
Stormwater Capacity Analysis for Potomac River Watershed, City of Alexandria, Virginia
City of Alexandria Storm Sewer Capacity Analysis



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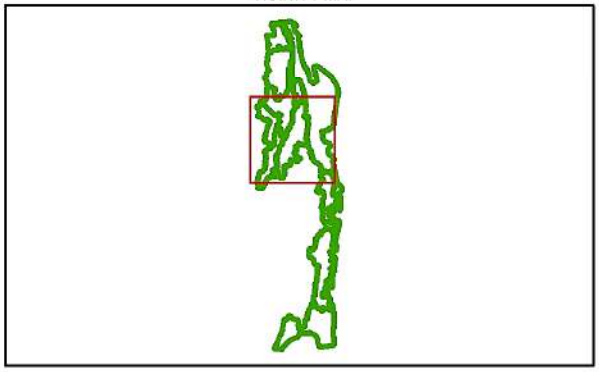


LEGEND

- DGravityMain
- Longest Flow Path
- Modeled Catchments
- Subwatersheds

DEM Elevation (ft)

High : 68

Low : 0

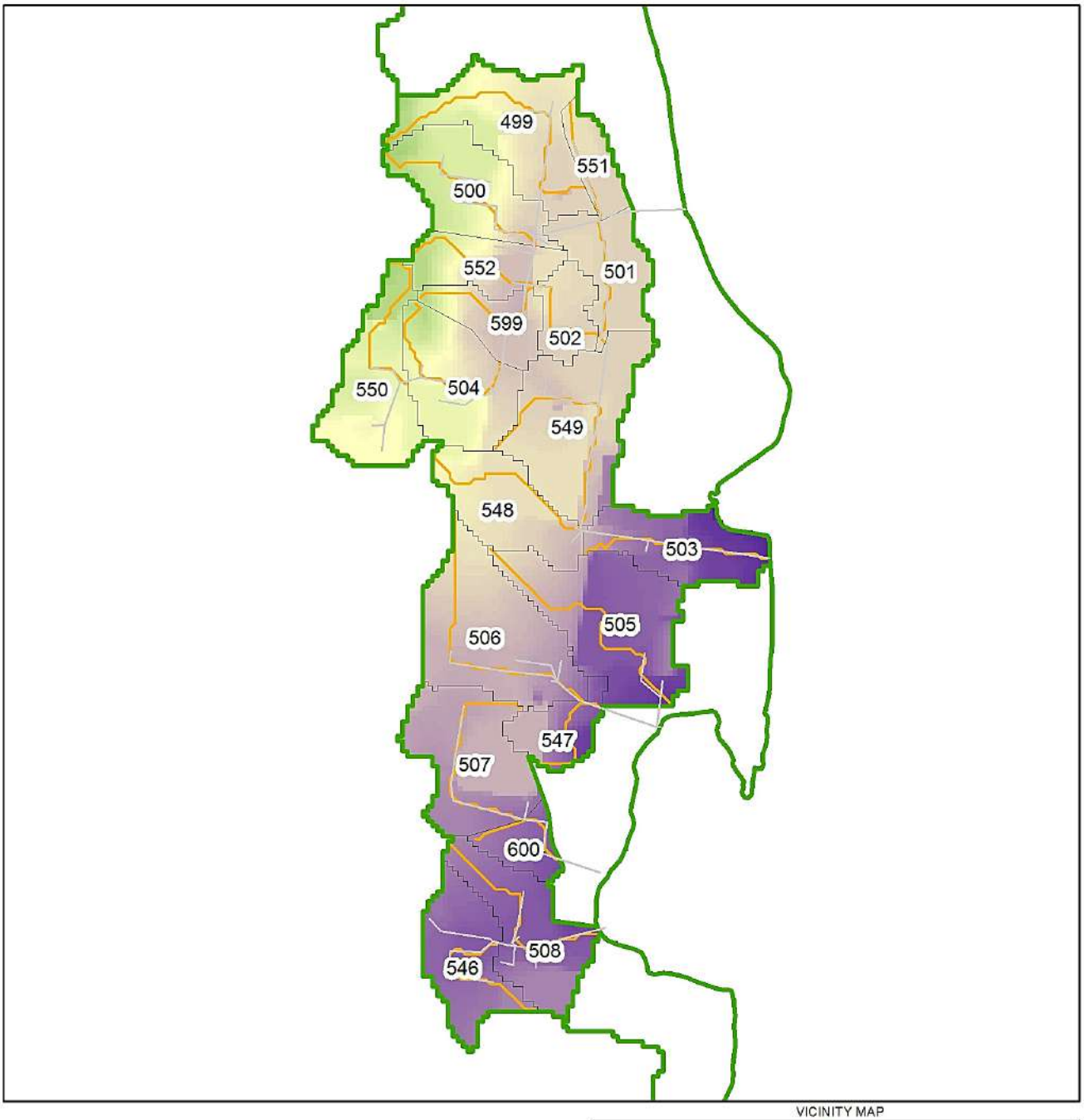
0 500 1,000

Feet

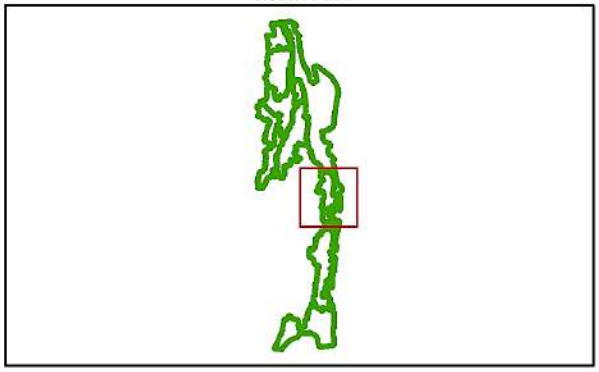
N

FIGURE 7
Potomac River Subwatershed 6 Catchments
Stormwater Capacity Analysis for Potomac River Watershed, City of Alexandria, Virginia
City of Alexandria Storm Sewer Capacity Analysis

CH2MHILL.



VICINITY MAP



LEGEND

- DGravityMain
- Longest Flow Path
- Modeled Catchments
- Subwatersheds

DEM Elevation (ft)

High : 68

Low : 0

0 500 1,000

Feet

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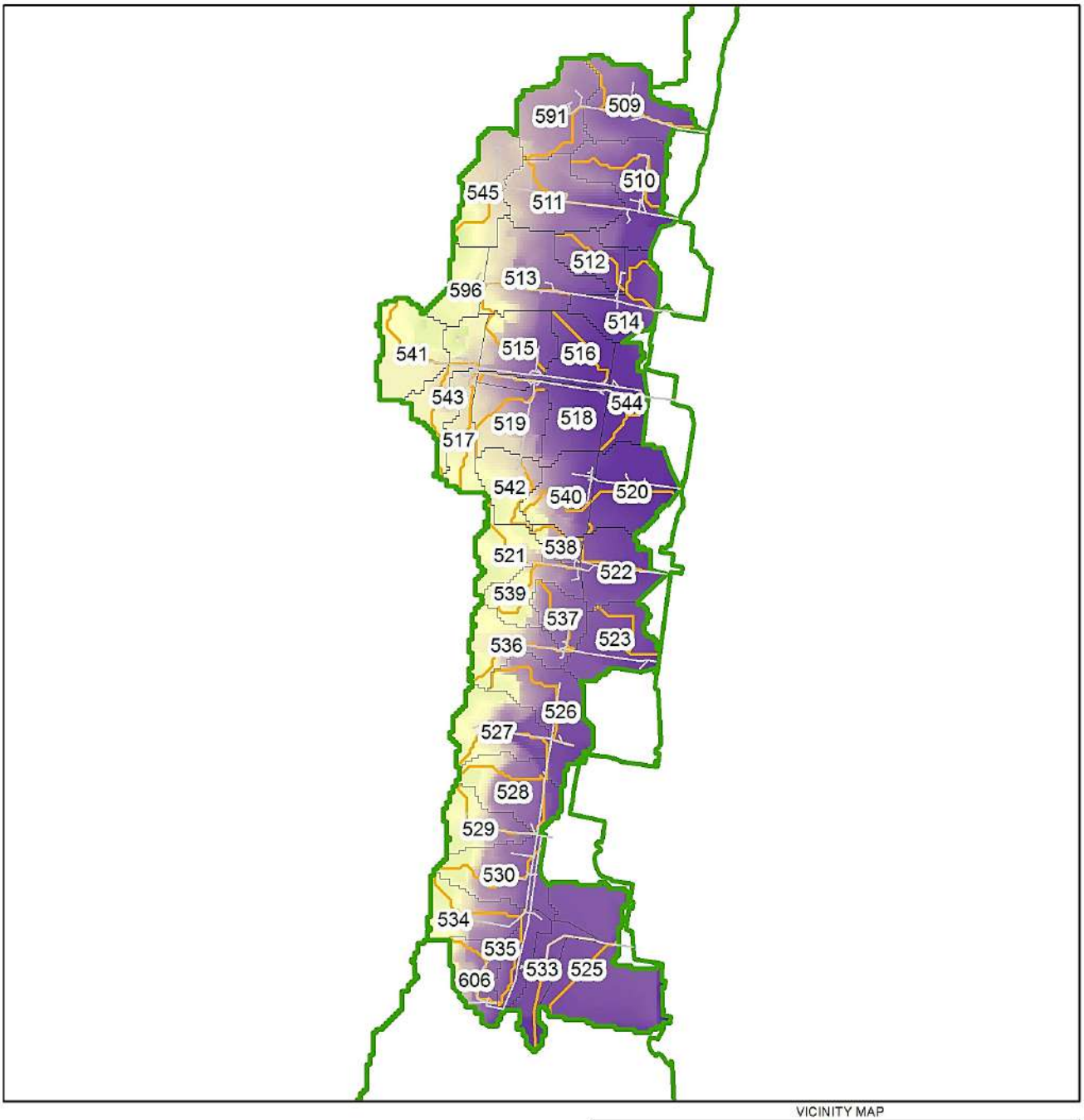
FIGURE 8
Potomac River Subwatershed 7 Catchments
Stormwater Capacity Analysis for Potomac River Watershed, City of Alexandria, Virginia
City of Alexandria Storm Sewer Capacity Analysis



LEGEND

- DGravityMain
- Longest Flow Path
- Modeled Catchments
- Subwatersheds

DEM Elevation (ft)

High : 68

Low : 0

0 500 1,000

Feet

N

VICINITY MAP

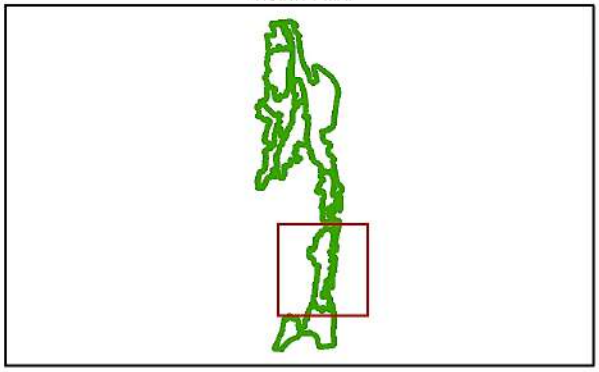


FIGURE 9
Potomac River Subwatershed 8 Catchments
Stormwater Capacity Analysis for Potomac River Watershed, City of Alexandria, Virginia
City of Alexandria Storm Sewer Capacity Analysis

Attachment C
Inlet Capacity Results

TABLE 1

Detailed Inlet Capacity Results for Potomac River

Sub-shed	Model Load Point	Total Drainage Area (ac)	Total Throat Count	Total Inlet Capacity (cfs)	Peak Runoff (cfs)	Inlet Capacity
0	005128IN	2.54	2	6.5	12.5	Insufficient
0	007222IN	2.141	5	16.3	10.2	
1	000014PD	2.092	2	6.5	8.6	Insufficient
1	001825SMH	5.122	6	19.5	26.8	Insufficient
1	001840SMH	4.884	5	16.3	26.5	Insufficient
1	004092SMH	1.534	4	13.0	8.5	
1	008095IN	1.722	6	19.5	8.7	
1	008099IN	2.361	5	16.3	12.5	
1	008101IN	12.382	18	58.5	61.5	Insufficient
2	000016PD-N	6.218	5	16.3	25.0	Insufficient
2	001861SMH	8.959	12	39.0	47.8	Insufficient
2	001862SMH	3.073	5	16.3	15.5	
2	004027SMH	1.675	6	19.5	9.5	
2	004101SMH	2.056	7	22.8	9.4	
2	004119SMH	1.373	4	13.0	4.1	
2	004121SMH	1.59	4	13.0	7.1	
2	004133SMH	1.014	7	22.8	4.8	
2	004137SMH	1.114	8	26.0	5.5	
2	004142SMH	2.9	8	26.0	11.1	
2	004144SMH	1.56	4	13.0	8.0	
2	004147SMH	1.482	4	13.0	5.8	
2	004149SMH	2.603	5	16.3	9.2	
2	004280SMH	1.904	5	16.3	10.7	
2	006285IN	3.655	6	19.5	20.8	Insufficient
2	008059IN	4.905	5	16.3	26.1	Insufficient
2	008061IN	2.02	5	16.3	11.4	
2	008067IN	3.832	8	26.0	20.7	
2	008130IN	3.701	3	9.8	5.0	
2	008133IN	3.302	2	6.5	4.7	
2	008155IN	5.002	6	19.5	18.2	
2	008162IN	2.874	7	22.8	14.1	
2	009111IN	1.104	5	16.3	4.4	
2	009116IN	3.27	6	19.5	5.8	
2	009128IN	2.675	6	19.5	13.6	
2	009162IN	2.913	3	9.8	4.9	
2	009169IN	0.785	2	6.5	4.1	
3	001810SMH	3.264	4	13.0	17.4	Insufficient
3	001843SMH	3.347	3	9.8	7.4	
3	004055SMH	1.406	3	9.8	7.1	
3	004069SMH	1.156	6	19.5	6.2	
3	004070SMH	0.666	2	6.5	3.4	
3	004073SMH	0.897	5	16.3	3.4	
3	004076SMH	2.546	8	26.0	12.3	
3	004154SMH	0.837	2	6.5	2.7	
3	004156SMH	2.061	4	13.0	5.0	
3	004158SMH	0.859	3	9.8	3.8	
3	004161SMH	0.832	1	3.3	3.8	Insufficient
3	004163SMH	1.28	5	16.3	6.4	
3	004164SMH	1.912	7	22.8	9.8	
3	004170SMH	2.542	6	19.5	12.4	
3	004222SMH	0.907	6	19.5	4.6	
3	004224SMH	6.131	3	9.8	9.9	Insufficient
3	004802SMH	1.808	5	16.3	7.3	

TABLE 1

Detailed Inlet Capacity Results for Potomac River

Sub-shed	Model Load Point	Total Drainage Area (ac)	Total Throat Count	Total Inlet Capacity (cfs)	Peak Runoff (cfs)	Inlet Capacity
3	004808SMH	1.678	7	22.8	8.6	
3	004810SMH	1.626	6	19.5	6.6	
3	004812SMH	1.375	8	26.0	5.8	
3	004813SMH	1.565	6	19.5	8.3	
3	004816SMH	2.246	6	19.5	9.9	
3	004819SMH	0.93	3	9.8	5.1	
3	004824SMH	1.589	3	9.8	8.0	
3	004826SMH	1.4	6	19.5	7.1	
3	004829SMH	0.878	3	9.8	4.7	
3	004849SMH	1.007	3	9.8	4.6	
3	006344IN	2.676	6	19.5	15.0	
3	006345IN	3.35	3	9.8	18.5	Insufficient
3	008135IN	2.809	3	9.8	4.5	
3	008138IN	4.561	2	6.5	8.3	Insufficient
3	009026IN	2.381	10	32.5	11.1	
3	009066IN	4.411	12	39.0	22.0	
3	009191IN	0.795	3	9.8	4.2	
4	000467IO	1.017	3	9.8	1.4	
4	001939SMH	2.737	3	9.8	13.5	Insufficient
4	002332SMH	2.24	4	13.0	2.9	
4	002688SMH	1.637	5	16.3	7.0	
4	004233SMH	2.328	7	22.8	9.8	
4	004239SMH	2.3	12	39.0	10.8	
4	004244SMH	0.573	9	29.3	2.8	
4	004248SMH	1.173	5	16.3	6.1	
4	004254SMH	0.387	3	9.8	2.2	
4	004255SMH	2.552	2	6.5	7.4	Insufficient
4	004256SMH	0.868	6	19.5	4.7	
4	004259SMH	1.543	5	16.3	7.9	
4	004264SMH	0.594	5	16.3	3.4	
4	004278SMH	3.565	1	3.3	9.0	Insufficient
4	004806SMH	2.753	6	19.5	12.5	
4	007480IN	1.647	3	9.8	1.7	
4	007962IN	3.799	11	35.8	12.2	
4	007984IN	0.884	3	9.8	3.4	
4	008240IN	1.942	6	19.5	10.8	
4	008244IN	1.62	2	6.5	7.3	Insufficient
4	008259IN	4.628	8	26.0	16.4	
4	008275IN	2.193	4	13.0	7.6	
4	008277IN	2.754	4	13.0	9.3	
4	009822IN	1.97	4	13.0	6.9	
4	009823IN	0.548	3	9.8	2.8	
5	000020PD	2.595	3	9.8	12.7	Insufficient
5	004086SMH	2.459	7	22.8	13.0	
5	004089SMH	2.327	6	19.5	10.8	
5	004173SMH	0.777	6	19.5	4.3	
5	004179SMH	1.769	8	26.0	8.5	
5	004181SMH	0.632	6	19.5	3.6	
5	004188SMH	15.364	14	45.5	55.6	Insufficient
5	004193SMH	14.256	11	35.8	32.2	
5	009228IN	0.476	4	13.0	2.8	
5	009255IN	1.563	4	13.0	5.9	
6	000017PD	1.325	0	0.0	4.2	Insufficient

TABLE 1

Detailed Inlet Capacity Results for Potomac River

Sub-shed	Model Load Point	Total Drainage Area (ac)	Total Throat Count	Total Inlet Capacity (cfs)	Peak Runoff (cfs)	Inlet Capacity
6	000877ND	3.518	9	29.3	16.4	
6	001108ND	2.727	8	26.0	13.8	
6	001885SMH	8.453	12	39.0	29.5	
6	001887SMH	2.789	3	9.8	12.1	Insufficient
6	001890SMH	2.19	4	13.0	8.6	
6	001897SMH	2.163	2	6.5	11.5	Insufficient
6	001898SMH	1.551	6	19.5	8.1	
6	001900SMH	2.738	8	26.0	11.8	
6	001923SMH	1.115	6	19.5	5.7	
6	002331SMH	2.293	4	13.0	9.8	
6	0023400ND	5.795	1	3.3	13.0	Insufficient
6	002443SMH	1.44	5	16.3	7.5	
6	002455SMH	0.739	4	13.0	3.9	
6	004112SMH	2.004	8	26.0	10.2	
6	004114SMH	2.738	10	32.5	13.6	
6	004199SMH	3.315	1	3.3	12.8	Insufficient
6	004220SMH	5.666	1	3.3	11.3	Insufficient
6	006484IN	4.22	3	9.8	16.1	Insufficient
6	006487IN	2.733	7	22.8	10.8	
6	007172IN	2.691	7	22.8	11.8	
6	007175IN	3.157	6	19.5	13.8	
6	007189IN	1.994	8	26.0	9.9	
6	007198IN	1.306	4	13.0	6.2	
6	007203IN	0.935	7	22.8	5.3	
6	007209IN	1.591	5	16.3	9.0	
6	007214IN	1.369	3	9.8	7.8	
6	007801IN	2.082	5	16.3	11.1	
6	007818IN	2.975	11	35.8	13.2	
6	007825IN	2.082	3	9.8	11.3	Insufficient
6	008201IN	2.944	5	16.3	10.0	
6	008283IN	2.119	11	35.8	9.9	
7	002350SMH	2.149	2	6.5	11.4	Insufficient
7	002352SMH	2.094	4	13.0	9.3	
7	002358SMH	3.688	10	32.5	21.2	
7	002362SMH	1.08	0	0.0	4.8	Insufficient
7	002365SMH	3.739	5	16.3	21.1	Insufficient
7	002382SMH	1.472	4	13.0	8.6	
7	002078ND	2.549	4	13.0	12.3	
7	002392SMH	1.242	3	9.8	7.2	
7	002395SMH	3.539	3	9.8	18.7	Insufficient
7	002474SMH	2.128	6	19.5	12.0	
7	002476SMH	2.464	6	19.5	12.6	
7	005133IN	2.417	8	26.0	13.4	
7	005136IN	0.829	3	9.8	2.2	
7	005138IN	1.678	4	13.0	5.7	
7	005145IN	3.139	7	22.8	16.3	
7	005163IN	0.968	8	26.0	5.6	
7	007252IN	0.78	4	13.0	3.6	
7	007253IN	2.979	4	13.0	15.6	Insufficient
7	002383SMH	2.573	3	9.8	13.3	Insufficient
8	0001091ND	2.221	4	13.0	12.8	
8	000383CB	0.615	1	3.3	3.4	Insufficient
8	002397SMH	2.593	4	13.0	14.6	Insufficient

TABLE 1

Detailed Inlet Capacity Results for Potomac River

Sub-shed	Model Load Point	Total Drainage Area (ac)	Total Throat Count	Total Inlet Capacity (cfs)	Peak Runoff (cfs)	Inlet Capacity
8	002398SMH	1.518	4	13.0	8.9	
8	002469SMH	3.365	4	13.0	19.7	Insufficient
8	002480SMH	3.628	6	19.5	19.5	
8	002483SMH	3.076	3	9.8	15.2	Insufficient
8	002486SMH	2.893	4	13.0	16.8	Insufficient
8	002503SMH	1.792	7	22.8	9.9	
8	002920SMH	2.433	2	6.5	14.1	Insufficient
8	002924SMH	2.106	5	16.3	12.0	
8	002925SMH	1.71	2	6.5	9.6	Insufficient
8	002927SMH	1.751	4	13.0	9.8	
8	002933SMH	2.29	6	19.5	13.0	
8	002935SMH	1.904	6	19.5	10.9	
8	002943SMH	2.465	4	13.0	14.3	Insufficient
8	002946SMH	2.276	3	9.8	13.2	Insufficient
8	002948SMH	1.457	1	3.3	8.5	Insufficient
8	002954SMH	2.471	3	9.8	13.3	Insufficient
8	002955SMH	3.663	3	9.8	20.7	Insufficient
8	002957SMH	2.006	2	6.5	11.4	Insufficient
8	002959SMH	1.596	3	9.8	9.1	
8	002960SMH	2.2	3	9.8	12.5	Insufficient
8	002962SMH	2.784	2	6.5	15.9	Insufficient
8	002966SMH	1.309	8	26.0	7.5	
8	002978SMH	1.792	4	13.0	9.7	
8	002987SMH	2.88	6	19.5	15.0	
8	002990SMH	1.702	3	9.8	9.1	
8	003006SMH	5.85	31	100.8	31.7	
8	004120SMH	2.655	1	3.3	7.9	Insufficient
8	005304IN	3.143	5	16.3	16.9	Insufficient
8	005337IN	3.244	6	19.5	14.9	
8	005341IN	2.753	6	19.5	11.6	
8	005344IN	1.719	10	32.5	7.8	
8	005351IN	1.411	5	16.3	8.1	
8	005396IN	2.123	3	9.8	11.2	Insufficient
8	007290IN	2.612	4	13.0	15.0	Insufficient

Attachment D
Detailed Model Results

TABLE 1

Potomac River Detailed Hydraulic Model Results

		Junction FaciltiyID						Duration of Surcharge (hrs)		Surcharge/ Depth Above Crown (ft)		Insufficient Freeboard/ Depth Below Rim (ft)		Duration of Flooding (hrs)		Flooded Volume (ft3)		
Subshed	DGravityMain FacilityID	US	DS	Length (ft)	Diameter/ Height x Width (ft)	Maximum Flow (ft3/s)	Maximum Velocity (fps)	US	DS	US	DS	US	DS	US	DS	US	DS	Summary Pipe Condition
0	007081STMP	005128IN	002372SMH	178.103	1.25	12.49	13.38	0	0	-	-	-	-	0	0	0	0	Sufficient Capacity
0	007966STMP	007218IN	007222IN	121.874	1.5	12.47	12.31	0	0	-	-	-	-	0	0	0	0	Sufficient Capacity
0	007969STMP	007222IN	002458SMH	74.502	1.5	22.47	20.45	0	0	-	-	-	-	0	0	0	0	Sufficient Capacity
0	007967STMP	002372SMH	007218IN	165.259	1.5	12.51	12.43	0	0	-	-	-	-	0	0	0	0	Sufficient Capacity
0	007970STMP	002458SMH	000472IO	98.387	1.5	22.47	19.15	0	49.8	-	Flooded	-	Flooded	0	0	0	0.19	Sufficient Capacity
1	010770STMP	000016CD	008126IN	146.774	3	105.86	14.84	0.5	0	2.491	0.524	-	-	0.47666667	0	20054.57	0	Surcharged
1	010768STMP	008092IN	000014PD	89.762	4	90.79	10.46	0	0	-	-	-	-	0	0	0	0	Sufficient Capacity
1	010772STMP	008093IN	008092IN	146.864	4	-90.73	7.86	0	0	-	-	-	-	0	0	0	0	Sufficient Capacity
1	010773STMP	008095IN	008093IN	118.326	4	90.55	12.2	0	0	-	-	-	-	0	0	0	0	Sufficient Capacity
1	010776STMP	008096IN	008095IN	46.391	2.25	20.9	11.55	0	0	-	-	-	-	0	0	0	0	Sufficient Capacity
1	010784STMP	008097IN	008096IN	46.359	2	20.85	8.32	0	0	-	-	-	-	0	0	0	0	Sufficient Capacity
1	010785STMP	008098IN	008097IN	126.915	2	20.8	9.02	0	0	-	-	-	-	0	0	0	0	Sufficient Capacity
1	010786STMP	008099IN	008098IN	127.966	1.5	12.37	7.01	0.2	0	0.919	-	-	-	0	0	0	0	Surcharged
1	010775STMP	008101IN	008095IN	67.785	4	61.39	9.64	0	0	-	-	-	-	0	0	0	0	Sufficient Capacity
1	010767STMP	001825SMH	000014PD	30.019	2.5	26.86	13.1	0	0	-	-	-	-	0	0	0	0	Sufficient Capacity
1	014788STMP	009093IN	008098IN	29.944	2	8.42	5.16	0	0	-	-	-	-	0	0	0	0	Sufficient Capacity
1	010798STMP	001840SMH	000014PD	136.459	3	26.41	4.44	0	0	-	0.357	-	-	0	0	0	0	Sufficient Capacity
1	014787STMP	004092SMH	009093IN	12.521	1.5	8.41	5.2	0	0	-	-	-	-	0	0	0	0	Sufficient Capacity
2	010648STMP	006285IN	008072IN	269.451	1.25	13.98	11.15	0.5	0	Flooded	0.125	Flooded	-	0.34	0	1068.41	0	Flooded
2	011886STMP	008059IN	008159IN	187.799	2.5	26.02	9.53	0	0	-	-	-	-	0	0	0	0	Sufficient Capacity
2	011888STMP	008061IN	000016PD-N	54.87	4.5	94.62	10.11	0	0	-	-	-	-	0	0	0	0	Sufficient Capacity
2	011889STMP	008064IN	008061IN	170.4	4.5	83.72	8.52	0	0	-	-	-	-	0	0	0	0	Sufficient Capacity
2	011199STMP	008065IN	008064IN	68.295	4.5	68.38	7.4	0	0	-	-	-	-	0	0	0	0	Sufficient Capacity
2	011200STMP	008067IN	008065IN	53.154	3	-20.71	2.99	0	0	-	-	-	-	0	0	0	0	Sufficient Capacity
2	011209STMP	008072IN	001864SMH	76.035	1.5	13.98	8.67	0	0	-	-	-	-	0	0	0	0	Sufficient Capacity
2	010799STMP	008126IN	000361IO	148.894	8	524.87	24.62	0	0	-	-	-	-	0	0	0	0	Sufficient Capacity
2	010803STMP	008130IN	008126IN	393.794	8	-419.05	10.51	0	0	-	-	-	-	0	0	0	0	Sufficient Capacity
2	010804STMP	008131IN	008130IN	401.696	8	413.96	9.45	0	0	-	-	-	-	0	0	0	0	Sufficient Capacity
2	010805STMP	008132IN	008131IN	390.623	8	413.86	8.86	0	0	-	-	-	-	0	0	0	0	Sufficient Capacity
2	015276STMP	008133IN	002080ND	220.417	6	413.81	14.58	0.7	0	3.505	1.458	-	-	0	0	0	0	Surcharged
2	014174STMP	004279SMH	004100SMH	60.573	2	13.48	7.44	0	0	-	-	-	-	0	0	0	0	Sufficient Capacity
2	014126STMP	004280SMH	004125SMH	168.333	2.5	19.13	6.39	0	0	-	-	-	-	0	0	0	0	Sufficient Capacity
2	014114STMP	004281SMH	004023SMH	46.258	2	8.79	7.73	0	0	-	-	-	-	0	0	0	0	Sufficient Capacity
2	010807STMP	0001052ND	008133IN	499.963	6	409.27	14.36	0.8	0.7	8.023	3.505	-	-	0	0	0	0	Surcharged
2	015277STMP	002080ND	008132IN	208.63	8	413.82	8.52	0	0	-	-	-	-	0	0	0	0	Sufficient Capacity
2	010765STMP	000369IO	0001052ND	68.81	6.5	167.83	15.96	0	0.8	-	7.523	-	-	0	0	0	0	Sufficient Capacity
2	011867STMP	008155IN	008156IN	128.722	4	71.42	9.04	0	0	-	-	-	-	0	0	0	0	Sufficient Capacity
2	011869STMP	008156IN	000016PD-N	182.625	4	71.31	8.29	0	0	-	-	-	-	0	0	0	0	Sufficient Capacity
2	011868STMP	008157IN	008155IN	304.486	4	53.93	8.39	0	0	-	-	-	-	0	0	0	0	Sufficient Capacity
2	011871STMP	008159IN	008157IN	51.278	4	53.75	7.09	0	0	-	-	-	-	0	0	0	0	Sufficient Capacity
2	011872STMP	008160IN	008159IN	187.555	3.5	27.96	5.51	0	0	-	-	-	-	0	0	0	0	Sufficient Capacity
2	011874STMP	008162IN	008160IN	173.498	3	27.93	7.4	0	0	-	-	-	-	0	0	0	0	Sufficient Capacity
2	011879STMP	008165IN	004281SMH	77.721	1.25	8.79	7.4	0	0	0.364	-	1.659	-	0	0	0	0	Insufficient Freeboard
2	011876STMP	008167IN	008162IN	67.973	3	14	4.6	0	0	-	-	-	-	0	0	0	0	Sufficient Capacity
2	011883STMP	008170IN	001859SMH	58.242	2.5	13.98	9.48	0	0	-	-	-	-	0	0	0	0	Sufficient Capacity
2	014219STMP	009111IN	004098SMH	95.471	5	106.67	10.41	0	0	-	-	-	-	0	0	0	0	Sufficient Capacity
2	014208STMP	009112IN	009111IN	151.156	5	102.48	10.17	0	0	-	-	-	-	0	0	0	0	Sufficient Capacity
2	014198STMP	009114IN	009112IN	112.113	3.5	47.51	7.86	0	0	-	-	-	-	0	0	0	0	Sufficient Capacity

TABLE 1

Potomac River Detailed Hydraulic Model Results

Subshed	DGravityMain FacilityID	Junction FaciltiyID		Length (ft)	Diameter/ Height x Width (ft)	Maximum Flow (ft3/s)	Maximum Velocity (fps)	Duration of Surcharge (hrs)		Surcharge/ Depth Above Crown (ft)		Insufficient Freeboard/ Depth Below Rim (ft)		Duration of Flooding (hrs)		Flooded Volume (ft3)		Summary Pipe Condition
		US	DS					US	DS	US	DS	US	DS	US	DS	US	DS	
2	014192STMP	009116IN	009114IN	196.925	3.5	47.45	9.23	0	0	-	-	-	-	0	0	0	0	Sufficient Capacity
2	014189STMP	009118IN	009116IN	192.729	3.5	41.67	9.09	0	0	-	-	-	-	0	0	0	0	Sufficient Capacity
2	014181STMP	009119IN	004099SMH	83.824	2.5	22.52	8.07	0	0	-	-	-	-	0	0	0	0	Sufficient Capacity
2	014171STMP	009128IN	004106SMH	69.974	2	13.46	5.9	0	0	-	-	-	-	0	0	0	0	Sufficient Capacity
2	014244STMP	009154IN	004138SMH	68.953	3	11.11	5.54	0	0	-	-	-	-	0	0	0	0	Sufficient Capacity
2	014241STMP	009156IN	009154IN	37.542	3	11.11	5.38	0	0	-	-	-	-	0	0	0	0	Sufficient Capacity
2	014884STMP	009162IN	004152SMH	77.018	2.5	4.91	4.38	0	0	-	-	-	-	0	0	0	0	Sufficient Capacity
2	014899STMP	009169IN	004145SMH	85.975	2	4.07	5.95	0	0	-	-	-	-	0	0	0	0	Sufficient Capacity
2	014896STMP	009172IN	004145SMH	131.378	2.5	7.91	5.04	0	0	-	-	-	-	0	0	0	0	Sufficient Capacity
2	014887STMP	009174IN	004145SMH	56.74	1.5	5.8	6.41	0	0	-	-	-	-	0	0	0	0	Sufficient Capacity
2	011880STMP	001859SMH	008167IN	18.458	2.5	13.98	7.91	0	0	-	-	-	-	0	0	0	0	Sufficient Capacity
2	011201STMP	001861SMH	008065IN	38.66	4.5	-47.76	4.54	0	0	-	-	-	-	0	0	0	0	Sufficient Capacity
2	011198STMP	001862SMH	008064IN	162.254	2.25	15.39	4.68	0	0	-	0.47	-	-	0	0	0	0	Sufficient Capacity
2	011208STMP	001864SMH	008170IN	176.147	2	13.98	9.18	0	0	-	-	-	-	0	0	0	0	Sufficient Capacity
2	014122STMP	004023SMH	004024SMH	42.452	2	8.8	5.23	0	0	-	-	-	-	0	0	0	0	Sufficient Capacity
2	015461STMP	004024SMH	004280SMH	47.783	2.5	8.84	4.29	0	0	-	-	-	-	0	0	0	0	Sufficient Capacity
2	014095STMP	004027SMH	004029SMH	67.569	1.5	9.11	5.88	0	0.1	-	0.15	-	-	0	0	0	0	Sufficient Capacity
2	014102STMP	004029SMH	004031SMH	81.314	1.5	8.99	4.89	0.1	0	0.3	0.052	-	-	0	0	0	0	Surcharged
2	014113STMP	004031SMH	008165IN	127.596	1.5	8.88	5.13	0	0	0.102	-	-	1.659	0	0	0	0	Surcharged
2	014222STMP	004098SMH	000016PD-S	52.119	5	106.72	10.63	0	0	-	-	-	-	0	0	0	0	Sufficient Capacity
2	014183STMP	004099SMH	009118IN	108.467	3.5	41.6	9.98	0	0	-	-	-	-	0	0	0	0	Sufficient Capacity
2	014178STMP	004100SMH	004101SMH	167.324	2.5	13.5	7.05	0	0	-	-	-	-	0	0	0	0	Sufficient Capacity
2	014179STMP	004101SMH	009119IN	79.13	2.5	22.51	8.74	0	0	-	-	-	-	0	0	0	0	Sufficient Capacity
2	015459STMP	004105SMH	004279SMH	42.248	2	13.46	7.42	0	0	-	-	-	-	0	0	0	0	Sufficient Capacity
2	014173STMP	004106SMH	004105SMH	138.896	2	13.46	5.83	0	0	-	-	-	-	0	0	0	0	Sufficient Capacity
2	015346STMP	004110SMH	004113SMH	22.553	3	3.32	3.43	0	0	-	-	-	-	0	0	0	0	Sufficient Capacity
2	014780STMP	004110SMH	004134SMH	59.004	1.25	7.67	13.59	0	0	-	-	-	-	0	0	0	0	Sufficient Capacity
2	014324STMP	004113SMH	004133SMH	124.364	4.5	50.43	7.77	0	0	-	-	-	-	0	0	0	0	Sufficient Capacity
2	014333STMP	004118SMH	004110SMH	128.004	2.5	10.99	5.21	0	0	-	-	-	-	0	0	0	0	Sufficient Capacity
2	014351STMP	004119SMH	004118SMH	18.52	2.5	11	4.99	0	0	-	-	-	-	0	0	0	0	Sufficient Capacity
2	014339STMP	004121SMH	004135SMH	170.415	2.5	7.05	4.84	0	0	-	-	-	-	0	0	0	0	Sufficient Capacity
2	014348STMP	004123SMH	004119SMH	73.022	2.5	7.02	4.08	0	0	-	-	-	-	0	0	0	0	Sufficient Capacity
2	014137STMP	004125SMH	004099SMH	66.755	3	19.14	7.97	0	0	-	-	-	-	0	0	0	0	Sufficient Capacity
2	014204STMP	004133SMH	009112IN	233.055	4.5	55.02	8.14	0	0	-	-	-	-	0	0	0	0	Sufficient Capacity
2	014346STMP	004135SMH	004123SMH	48.284	2.5	7.02	4.57	0	0	-	-	-	-	0	0	0	0	Sufficient Capacity
2	014258STMP	004136SMH	004113SMH	114.846	4.5	47.14	7.65	0	0	-	-	-	-	0	0	0	0	Sufficient Capacity
2	014256STMP	004137SMH	004136SMH	85.471	4	47.12	7.81	0	0	-	-	-	-	0	0	0	0	Sufficient Capacity
2	014247STMP	004138SMH	004137SMH	144.58	4	42.08	7.31	0	0	-	-	-	-	0	0	0	0	Sufficient Capacity
2	014238STMP	004139SMH	009156IN	27.308	2	11.12	6.34	0	0	-	-	-	-	0	0	0	0	Sufficient Capacity
2	014237STMP	004141SMH	004139SMH	54.95	2	11.11	10.4	0	0	-	-	-	-	0	0	0	0	Sufficient Capacity
2	014235STMP	004142SMH	004141SMH	72.453	2	11.1	11.31	0	0	-	-	-	-	0	0	0	0	Sufficient Capacity
2	014895STMP	004144SMH	009172IN	23.551	2.5	7.92	4.63	0	0	-	-	-	-	0	0	0	0	Sufficient Capacity
2	014879STMP	004145SMH	004148SMH	46.5	3	17.75	6.18	0	0	-	-	-	-	0	0	0	0	Sufficient Capacity
2	014888STMP	004146SMH	009174IN	22.649	1.5	5.79	4.67	0	0	-	-	-	-	0	0	0	0	Sufficient Capacity
2	014890STMP	004147SMH	004146SMH	89.48	1.5	5.8	6.33	0	0	-	-	-	-	0	0	0	0	Sufficient Capacity
2	014880STMP	004148SMH	004149SMH	176.741	3	17.77	6.12	0	0	-	-	-	-	0	0	0	0	Sufficient Capacity
2	014881STMP	004149SMH	004150SMH	176.07	3	26.57	6.84	0	0	-	-	-	-	0	0	0	0	Sufficient Capacity
2	014875STMP	004150SMH	004151SMH	99.933	3.5	26.61	6.81	0	0	-	-	-	-	0	0	0	0	Sufficient Capacity

TABLE 1

Potomac River Detailed Hydraulic Model Results

Subshed	DGravityMain FacilityID	Junction FaciltiyID		Length (ft)	Diameter/ Height x Width (ft)	Maximum Flow (ft3/s)	Maximum Velocity (fps)	Duration of Surcharge (hrs)		Surcharge/ Depth Above Crown (ft)		Insufficient Freeboard/ Depth Below Rim (ft)		Duration of Flooding (hrs)		Flooded Volume (ft3)		Summary Pipe Condition
		US	DS					US	DS	US	DS	US	DS	US	DS	US	DS	
2	014882STMP	004151SMH	004152SMH	233.986	3.5	26.64	6.73	0	0	-	-	-	-	0	0	0	0	Sufficient Capacity
2	014886STMP	004152SMH	004138SMH	152.547	4	31.45	7.04	0	0	-	-	-	-	0	0	0	0	Sufficient Capacity
2	015465STMP	000594IO	008135IN	97.905	4	142.45	15.34	0.5	0.8	2.101	10.38	-	0.12	0	0	0	0	Surcharged
3	010742STMP	006344IN	009033IN	65.189	2	15.02	6.21	0	0	-	-	-	-	0	0	0	0	Sufficient Capacity
3	010743STMP	006345IN	009030IN	65.555	1.25	17.7	14.22	0.2	0	2.926	1.416	0.344	-	0	0	0	0	Insufficient Freeboard
3	010748STMP	006349IN	006350IN	52.802	2	17.25	6.38	0	0	-	0.051	-	-	0	0	0	0	Sufficient Capacity
3	010749STMP	006350IN	004045SMH	21.269	2	-17.25	5.52	0	0	0.051	-	-	-	0	0	0	0	Surcharged
3	015279STMP	008134IN	0001052ND	30.095	6	293.03	10.29	0.9	0.8	8.137	8.023	0.663	-	0	0	0	0	Insufficient Freeboard
3	010490STMP	008135IN	008134IN	412.756	6	293.01	10.28	0.8	0.9	8.38	8.137	0.12	0.663	0	0	0	0	Insufficient Freeboard
3	010808STMP	008136IN	008135IN	258.666	6	263.15	9.24	0.7	0.8	8.213	8.38	-	0.12	0	0	0	0	Surcharged
3	010809STMP	008137IN	008136IN	243.365	6	263.24	9.25	0.4	0.7	7.278	8.213	1.022	-	0	0	0	0	Insufficient Freeboard
3	010810STMP	008138IN	008137IN	210.733	6	256.3	9.84	0.6	0.4	6.522	7.278	1.978	1.022	0	0	0	0	Insufficient Freeboard
3	010811STMP	008139IN	008138IN	523.473	6	248.52	11.57	0.5	0.6	4.066	6.522	0.434	1.978	0	0	0	0	Insufficient Freeboard
3	010751STMP	001810SMH	001812SMH	182.064	2	17.31	7.67	0	0	-	-	-	-	0	0	0	0	Sufficient Capacity
3	010750STMP	001812SMH	006349IN	86.835	2	17.25	6.74	0	0	-	-	-	-	0	0	0	0	Sufficient Capacity
3	014047STMP	004282SMH	004856SMH	52.992	2.5	12.1	6.05	0	0	-	-	-	-	0	0	0	0	Sufficient Capacity
3	015375STMP	004283SMH	001842SMH	19.062	3.5	93.84	14.14	0.1	0.4	1.102	3.007	-	-	0	0	0	0	Surcharged
3	015170STMP	009803IN	004805SMH	69.824	3.5	45.71	10.59	0	0	-	-	-	-	0	0	0	0	Sufficient Capacity
3	015188STMP	009810IN	004819SMH	36.556	2.5	9.92	6.33	0	0	-	-	-	-	0	0	0	0	Sufficient Capacity
3	015217STMP	009809IN	009820IN	80.762	3	14.86	4.51	0	0	-	-	-	-	0	0	0	0	Sufficient Capacity
3	015191STMP	009811IN	009812IN	76.753	2.5	14.87	6.2	0	0	-	-	-	-	0	0	0	0	Sufficient Capacity
3	015192STMP	009812IN	004821SMH	23.175	2.5	14.87	5.08	0	0	-	-	-	-	0	0	0	0	Sufficient Capacity
3	015198STMP	009813IN	004825SMH	86.891	2	4.49	4.35	0	0	-	-	-	-	0	0	0	0	Sufficient Capacity
3	015199STMP	009814IN	009813IN	78.98	2	4.49	7.68	0	0	-	-	-	-	0	0	0	0	Sufficient Capacity
3	015218STMP	009820IN	004284SMH	9.126	3	14.87	5.11	0	0	-	-	-	-	0	0	0	0	Sufficient Capacity
3	015216STMP	009821IN	004830SMH	18.623	3	20.5	5.95	0	0	-	-	-	-	0	0	0	0	Sufficient Capacity
3	015284STMP	009249IN	001843SMH	25.552	2.25	11.48	9.39	0.3	0.3	1.804	5.74	-	-	0	0	0	0	Surcharged
3	015235STMP	009250IN	009249IN	48.642	2.25	11.36	7.57	0.3	0.3	1.144	1.804	-	-	0	0	0	0	Surcharged
3	015234STMP	009252IN	009250IN	67.98	2	10.92	7.98	0.1	0.3	0.438	1.394	-	-	0	0	0	0	Surcharged
3	015281STMP	009817IN	009809IN	12.41	3	14.86	4.18	0	0	-	-	-	-	0	0	0	0	Sufficient Capacity
3	015099STMP	009026IN	004045SMH	46.719	1.5	10.91	6.1	0	0	0.074	-	-	-	0	0	0	0	Surcharged
3	015144STMP	009029IN	009030IN	171.631	3	28.24	7.37	0	0	-	-	-	-	0	0	0	0	Sufficient Capacity
3	015145STMP	009030IN	009032IN	8.398	3	45.64	6.91	0	0	-	-	-	-	0	0	0	0	Sufficient Capacity
3	015146STMP	009032IN	009803IN	140.774	3	45.67	7.26	0	0	-	-	-	-	0	0	0	0	Sufficient Capacity
3	015152STMP	009033IN	009034IN	8.354	2	15.02	5.91	0	0	-	-	-	-	0	0	0	0	Sufficient Capacity
3	015147STMP	009034IN	009061IN	144.424	2	15.02	7.56	0	0	-	-	-	-	0	0	0	0	Sufficient Capacity
3	015148STMP	009061IN	004800SMH	73.771	3.5	36.43	6.65	0	0	-	-	-	-	0	0	0	0	Sufficient Capacity
3	015312STMP	009063IN	009061IN	155.046	3	21.45	5.23	0	0	-	-	-	-	0	0	0	0	Sufficient Capacity
3	015311STMP	009066IN	009063IN	49.641	2.5	21.45	6.2	0	0	-	-	-	-	0	0	0	0	Sufficient Capacity
3	014867STMP	009183IN	004154SMH	10.012	3	25.93	6.08	0	0	-	-	-	-	0	0	0	0	Sufficient Capacity
3	014865STMP	009184IN	009185IN	49.313	2.5	21.12	6.53	0	0	-	-	-	-	0	0	0	0	Sufficient Capacity
3	014866STMP	009185IN	009183IN	71.504	3	25.93	7.97	0	0	-	-	-	-	0	0	0	0	Sufficient Capacity
3	014847STMP	009188IN	004160SMH	20.222	3	36.66	7.36	0	0	-	-	-	-	0	0	0	0	Sufficient Capacity
3	014846STMP	009190IN	004161SMH	155.611	3	20.24	5.98	0	0	-	-	-	-	0	0	0	0	Sufficient Capacity
3	014844STMP	009191IN	009190IN	102.07	3	20.23	6.64	0	0	-	-	-	-	0	0	0	0	Sufficient Capacity
3	014807STMP	009295IN	009814IN	57.593	1.5	4.49	4.46	0	0	-	-	-	-	0	0	0	0	Sufficient Capacity
3	010812STMP	001843SMH	008139IN	256.083	6	248.12	13.97	0.3	0.5	1.99	4.066	-	0.434	0	0	0	0	Surcharged
3	015197STMP	004825SMH	004824SMH	228.666	4.5	54.9	5.36	0	0	-	-	-	-	0	0	0	0	Sufficient Capacity

TABLE 1

Potomac River Detailed Hydraulic Model Results

Subshed	DGravityMain FacilityID	Junction FaciltiyID		Length (ft)	Diameter/ Height x Width (ft)	Maximum Flow (ft3/s)	Maximum Velocity (fps)	Duration of Surcharge (hrs)		Surcharge/ Depth Above Crown (ft)		Insufficient Freeboard/ Depth Below Rim (ft)		Duration of Flooding (hrs)		Flooded Volume (ft3)		Summary Pipe Condition
		US	DS					US	DS	US	DS	US	DS	US	DS	US	DS	
3	015196STMP	004824SMH	004823SMH	196.267	4.5	57.15	6.92	0	0	-	-	-	-	0	0	0	0	Sufficient Capacity
3	015185STMP	004816SMH	004817SMH	99.085	2	9.89	7.98	0	0	-	-	-	-	0	0	0	0	Sufficient Capacity
3	015186STMP	004817SMH	004818SMH	39.397	2.5	9.9	4.54	0	0	-	-	-	-	0	0	0	0	Sufficient Capacity
3	015187STMP	004818SMH	009810IN	62.247	2.5	-9.91	3.78	0	0	-	-	-	-	0	0	0	0	Sufficient Capacity
3	015189STMP	004819SMH	004820SMH	211.708	2.5	14.86	6.84	0	0	-	-	-	-	0	0	0	0	Sufficient Capacity
3	015190STMP	004820SMH	009811IN	56.019	2.5	-14.85	4.6	0	0	-	-	-	-	0	0	0	0	Sufficient Capacity
3	015194STMP	004823SMH	004822SMH	86.007	3.583 x 5.667	57.18	6	0	0	-	-	-	-	0	0	0	0	Sufficient Capacity
3	015195STMP	004822SMH	004849SMH	136.087	5	62.65	7.13	0	0	-	-	-	-	0	0	0	0	Sufficient Capacity
3	015193STMP	004821SMH	004822SMH	24.356	2.5	14.85	5.07	0	0	-	-	-	-	0	0	0	0	Sufficient Capacity
3	015181STMP	004826SMH	004815SMH	114.153	2	6.98	3.12	0	0	-	-	-	-	0	0	0	0	Sufficient Capacity
3	015182STMP	004815SMH	004814SMH	39.743	2	-6.97	3.04	0	0	-	-	-	-	0	0	0	0	Sufficient Capacity
3	015183STMP	004814SMH	004813SMH	283.231	2.5	6.97	4.58	0	0	-	-	-	-	0	0	0	0	Sufficient Capacity
3	015184STMP	004813SMH	004846SMH	37.357	3	14.85	3.88	0	0	-	-	-	-	0	0	0	0	Sufficient Capacity
3	015177STMP	004807SMH	004843SMH	269.449	4.5	96.17	7.68	0	0	-	-	-	-	0	0	0	0	Sufficient Capacity
3	015178STMP	004808SMH	004844SMH	26.318	2.5	8.44	3.72	0	0	-	-	-	-	0	0	0	0	Sufficient Capacity
3	015167STMP	004802SMH	004801SMH	73.08	3	-7.11	1.86	0	0	-	-	-	-	0	0	0	0	Sufficient Capacity
3	015169STMP	004800SMH	004801SMH	85.732	3.5	36.42	7.28	0	0	-	-	-	-	0	0	0	0	Sufficient Capacity
3	015168STMP	004801SMH	004852SMH	324.823	3.5	43.22	5.54	0	0	-	-	-	-	0	0	0	0	Sufficient Capacity
3	015171STMP	004805SMH	004804SMH	178.248	3.5	45.76	9.71	0	0	-	-	-	-	0	0	0	0	Sufficient Capacity
3	015222STMP	004804SMH	004853SMH	236.171	3.5	45.77	9.77	0	0	-	-	-	-	0	0	0	0	Sufficient Capacity
3	015200STMP	004849SMH	004848SMH	163.566	5	64.76	7.46	0	0	-	-	-	-	0	0	0	0	Sufficient Capacity
3	015201STMP	004848SMH	004829SMH	246.047	6	74.26	7.24	0	0	-	-	-	-	0	0	0	0	Sufficient Capacity
3	015202STMP	004829SMH	004830SMH	280.303	6	87.68	7.63	0	0	-	-	-	-	0	0	0	0	Sufficient Capacity
3	015203STMP	004830SMH	004831SMH	59.289	6	106.63	8.29	0	0	-	-	-	-	0	0	0	0	Sufficient Capacity
3	015204STMP	004831SMH	004832SMH	172.177	6	106.18	7.35	0	0	-	-	-	-	0	0	0	0	Sufficient Capacity
3	015205STMP	004832SMH	004833SMH	304.933	6	103.82	7.75	0	0	-	-	-	-	0	0	0	0	Sufficient Capacity
3	015206STMP	004833SMH	004834SMH	169.67	6	134.27	9.35	0	0	-	-	-	-	0	0	0	0	Sufficient Capacity
3	015207STMP	004834SMH	004835SMH	166.227	6	213.28	12.93	0	0.1	-	0.244	-	-	0	0	0	0	Sufficient Capacity
3	015288STMP	004835SMH	004159SMH	28.242	6	208.12	12.24	0.1	0.2	0.244	0.467	-	-	0	0	0	0	Surcharged
3	010487STMP	004836SMH	001843SMH	60.717	6	233.33	14.25	0.3	0.3	1.408	1.99	-	-	0	0	0	0	Surcharged
3	015209STMP	004838SMH	004837SMH	232.133	4.5	93.74	9.24	0	0	-	-	-	-	0	0	0	0	Sufficient Capacity
3	015287STMP	004837SMH	004283SMH	21.339	4.5	93.82	10.62	0	0.1	0.067	0.102	-	-	0	0	0	0	Surcharged
3	015211STMP	004839SMH	004838SMH	114.587	4.5	95.23	9.06	0	0	-	-	-	-	0	0	0	0	Sufficient Capacity
3	015210STMP	004840SMH	004839SMH	101.49	4.5	96.1	9.29	0	0	-	-	-	-	0	0	0	0	Sufficient Capacity
3	015212STMP	004841SMH	004840SMH	400.944	4.5	96.44	9.44	0	0	-	-	-	-	0	0	0	0	Sufficient Capacity
3	014084STMP	004844SMH	004170SMH	305.491	3	8.36	3.29	0	0	-	-	-	-	0	0	0	0	Sufficient Capacity
3	015214STMP	004843SMH	004842SMH	322.278	4.5	96.33	9.77	0	0	-	-	-	-	0	0	0	0	Sufficient Capacity
3	015213STMP	004842SMH	004841SMH	226.278	4.5	96.43	9.44	0	0	-	-	-	-	0	0	0	0	Sufficient Capacity
3	015280STMP	004846SMH	009817IN	17.353	3	14.85	4	0	0	-	-	-	-	0	0	0	0	Sufficient Capacity
3	015224STMP	004850SMH	004834SMH	219.858	6	87.78	8.78	0	0	-	-	-	-	0	0	0	0	Sufficient Capacity
3	015221STMP	004852SMH	004853SMH	245.545	3.5	43.17	6.75	0	0	-	-	-	-	0	0	0	0	Sufficient Capacity
3	015223STMP	004853SMH	004850SMH	73.866	6	88.56	8.3	0	0	-	-	-	-	0	0	0	0	Sufficient Capacity
3	015225STMP	004810SMH	004811SMH	158.135	2	6.47	4.82	0	0	-	-	-	-	0	0	0	0	Sufficient Capacity
3	015226STMP	004811SMH	004854SMH	32.196	2	6.48	4.81	0	0	-	-	-	-	0	0	0	0	Sufficient Capacity
3	015229STMP	004812SMH	004282SMH	32.371	2.5	12.09	5.99	0	0	-	-	-	-	0	0	0	0	Sufficient Capacity
3	015230STMP	004856SMH	004857SMH	41.404	2.5	12.11	7.32	0	0	-	-	-	-	0	0	0	0	Sufficient Capacity
3	015231STMP	004857SMH	004858SMH	59.935	3	12.13	6.48	0	0	-	-	-	-	0	0	0	0	Sufficient Capacity
3	015232STMP	004858SMH	004851SMH	16.675	3	12.14	4.84	0	0	-	-	-	-	0	0	0	0	Sufficient Capacity

TABLE 1

Potomac River Detailed Hydraulic Model Results

		Junction FaciltiyID						Duration of Surcharge (hrs)		Surcharge/ Depth Above Crown (ft)		Insufficient Freeboard/ Depth Below Rim (ft)		Duration of Flooding (hrs)		Flooded Volume (ft3)		
Subshed	DGravityMain FacilityID	US	DS	Length (ft)	Diameter/ Height x Width (ft)	Maximum Flow (ft3/s)	Maximum Velocity (fps)	US	DS	US	DS	US	DS	US	DS	US	DS	Summary Pipe Condition
3	015233STMP	004851SMH	004829SMH	32.269	3	12.15	5.06	0	0	-	-	-	-	0	0	0	0	Sufficient Capacity
3	015227STMP	004854SMH	004855SMH	18.005	2	6.48	4.82	0	0	-	-	-	-	0	0	0	0	Sufficient Capacity
3	015228STMP	004855SMH	004812SMH	36.715	2	6.48	6.77	0	0	-	-	-	-	0	0	0	0	Sufficient Capacity
3	015376STMP	001842SMH	004278SMH	413.635	3.5	93.85	9.66	0.4	0.3	3.007	0.491	-	-	0	0	0	0	Surcharged
3	014045STMP	004284SMH	004848SMH	17.194	3	14.87	4.98	0	0	-	-	-	-	0	0	0	0	Sufficient Capacity
3	015129STMP	004045SMH	009029IN	140.983	3	28.2	7.61	0	0	-	-	-	-	0	0	0	0	Sufficient Capacity
3	015156STMP	004055SMH	004057SMH	147.512	1.5	6.96	4.92	0	0	-	-	-	-	0	0	0	0	Sufficient Capacity
3	015159STMP	004057SMH	004062SMH	46.7	1.5	6.96	5.17	0	0	-	-	-	-	0	0	0	0	Sufficient Capacity
3	015160STMP	004062SMH	004069SMH	124.854	1.5	6.97	4.79	0	0	-	-	-	-	0	0	0	0	Sufficient Capacity
3	015215STMP	004069SMH	004077SMH	64.12	1.5	12.85	7	0	0	0.211	-	-	-	0	0	0	0	Surcharged
3	015289STMP	004070SMH	004074SMH	111.055	1.5	3.33	4.26	0	0	-	-	-	-	0	0	0	0	Sufficient Capacity
3	015291STMP	004071SMH	004072SMH	145.469	1.5	11.18	6.37	0	0	0.415	-	-	-	0	0	0	0	Surcharged
3	015293STMP	004072SMH	004074SMH	46.648	1.5	11.19	6.3	0	0	0.05	-	-	-	0	0	0	0	Surcharged
3	015303STMP	004073SMH	004078SMH	60.796	2	17.56	7.34	0	0	-	-	-	-	0	0	0	0	Sufficient Capacity
3	015295STMP	004074SMH	004073SMH	123.236	2	14.35	6.27	0	0	-	-	-	-	0	0	0	0	Sufficient Capacity
3	015300STMP	004076SMH	004071SMH	71.653	1.5	11.34	6.36	0	0	0.433	0.165	-	-	0	0	0	0	Surcharged
3	014842STMP	004077SMH	004161SMH	116.95	2	12.87	5.65	0	0	-	-	-	-	0	0	0	0	Sufficient Capacity
3	014862STMP	004078SMH	004158SMH	108.88	2.5	17.58	6.59	0	0	-	-	-	-	0	0	0	0	Sufficient Capacity
3	014781STMP	004134SMH	008137IN	76.967	1.25	7.67	13.21	0	0.4	-	1.528	-	1.022	0	0	0	0	Sufficient Capacity
3	014868STMP	004154SMH	004159SMH	36.826	3	28.36	6.96	0	0.2	1.873	2.167	-	-	0	0	0	0	Surcharged
3	014870STMP	004154SMH	004272SMH	297.049	1.25	1.51	3.4	0	0.5	-	5.271	-	-	0	0	0	0	Sufficient Capacity
3	014861STMP	004156SMH	009185IN	55.509	2.5	4.96	4.65	0	0	-	-	-	-	0	0	0	0	Sufficient Capacity
3	014864STMP	004158SMH	009184IN	82.67	2.5	21.11	6.45	0	0	-	-	-	-	0	0	0	0	Sufficient Capacity
3	015208STMP	004159SMH	004836SMH	163.164	6	234.5	13.62	0.2	0.3	0.467	1.408	-	-	0	0	0	0	Surcharged
3	014848STMP	004160SMH	004833SMH	20.293	3	36.67	8.28	0	0	-	-	-	-	0	0	0	0	Sufficient Capacity
3	014849STMP	004160SMH	004274SMH	121.17	1.25	0	0	0	0	-	-	-	-	0	0	0	0	Sufficient Capacity
3	015350STMP	004161SMH	009188IN	34.671	3	36.64	8.57	0	0	-	-	-	-	0	0	0	0	Sufficient Capacity
3	015359STMP	004163SMH	004168SMH	181.014	2	6.34	4.83	0	0	-	-	-	-	0	0	0	0	Sufficient Capacity
3	015353STMP	004164SMH	004165SMH	49.405	3	16.02	6.06	0	0	-	-	-	-	0	0	0	0	Sufficient Capacity
3	014838STMP	004165SMH	004166SMH	41.299	3	16.05	6.48	0	0	-	-	-	-	0	0	0	0	Sufficient Capacity
3	014843STMP	004166SMH	009191IN	74.071	3	16.09	6.33	0	0	-	-	-	-	0	0	0	0	Sufficient Capacity
3	015354STMP	004167SMH	004164SMH	50.318	2.5	6.36	4.72	0	0	-	-	-	-	0	0	0	0	Sufficient Capacity
3	015358STMP	004168SMH	004167SMH	35.37	2	6.35	5.02	0	0	-	-	-	-	0	0	0	0	Sufficient Capacity
3	014086STMP	004169SMH	004276SMH	43.241	3	20.46	5.88	0	0	-	-	-	-	0	0	0	0	Sufficient Capacity
3	014087STMP	004170SMH	004169SMH	69.381	3	20.45	5.81	0	0	-	-	-	-	0	0	0	0	Sufficient Capacity
3	014806STMP	004222SMH	009295IN	14.554	1.5	4.49	4.08	0	0	-	-	-	-	0	0	0	0	Sufficient Capacity
3	014853STMP	004224SMH	004225SMH	391.09	2.25	9.79	5.2	0	0	-	-	-	-	0	0	0	0	Sufficient Capacity
3	014854STMP	004225SMH	009252IN	436.916	2.25	10.39	5.26	0	0.1	-	0.188	-	-	0	0	0	0	Sufficient Capacity
3	014871STMP	004272SMH	004273SMH	145.316	1.25	-3.07	-2.45	0.5	0.6	5.271	6.62	-	-	0	0	0	0	Surcharged
3	014872STMP	004273SMH	008139IN	37.002	1.25	-3.75	-2.98	0.6	0.5	6.62	7.016	-	0.434	0	0	0	0	Surcharged
3	014850STMP	004274SMH	004225SMH	109.915	1.25	0	0	0	0	-	-	-	-	0	0	0	0	Sufficient Capacity
3	014085STMP	004276SMH	009821IN	77.938	3	20.49	6.56	0	0	-	-	-	-	0	0	0	0	Sufficient Capacity
4	015314STMP	006537IN	004079SMH	78.334	1.5	11.5	10.78	0	0	-	-	-	-	0	0	0	0	Sufficient Capacity
4	012126STMP	007479IN	002333SMH	27.95	2	5.88	6.28	0	0	-	-	-	-	0	0	0	0	Sufficient Capacity
4	012127STMP	007480IN	007479IN	172.573	2	5.88	6.69	0	0	-	-	-	-	0	0	0	0	Sufficient Capacity
4	010389STMP	007961IN	008214IN	88.585	1.5	11.5	7.61	0.5	0.5	1.345	1.975	0.855	0.175	0	0	0	0	Insufficient Freeboard
4	010390STMP	007962IN	007961IN	93.453	1.5	11.51	6.45	0.5	0.5	Flooded	1.345	Flooded	0.855	0.22833333	0	323.4	0	Flooded
4	010391STMP	007979IN	007962IN	89.746	1.25	4.87	3.94	0.5	0.5	Flooded	Flooded	Flooded	Flooded	0.16666667	0.22833333	76.11	323.4	Flooded

TABLE 1

Potomac River Detailed Hydraulic Model Results

		Junction FaciltiyID						Duration of Surcharge (hrs)		Surcharge/ Depth Above Crown (ft)		Insufficient Freeboard/ Depth Below Rim (ft)		Duration of Flooding (hrs)		Flooded Volume (ft3)		
Subshed	DGravityMain FacilityID	US	DS	Length (ft)	Diameter/ Height x Width (ft)	Maximum Flow (ft3/s)	Maximum Velocity (fps)	US	DS	US	DS	US	DS	US	DS	US	DS	Summary Pipe Condition
4	010392STMP	007980IN	007979IN	34.569	1.25	4.85	3.92	0.5	0.5	Flooded	Flooded	Flooded	Flooded	0.3	0.16666667	312.58	76.11	Flooded
4	010393STMP	007981IN	007980IN	79.125	1.25	4.83	3.9	0.5	0.5	Flooded	Flooded	Flooded	Flooded	0.345	0.3	461.53	312.58	Flooded
4	010394STMP	007982IN	007981IN	39.083	1.25	-4.82	3.88	0.5	0.5	Flooded	Flooded	Flooded	Flooded	0.41	0.345	693.59	461.53	Flooded
4	010395STMP	007983IN	007982IN	121.209	1.25	3.34	5.25	0.3	0.5	0.1	Flooded	1.25	Flooded	0	0.41	0	693.59	Insufficient Freeboard
4	009858STMP	007984IN	007983IN	24.906	1	-3.33	4.21	0.7	0.3	1.301	0.35	1.049	1.25	0	0	0	0	Insufficient Freeboard
4	015262STMP	008211IN	004079SMH	99.948	2.5	5.89	5.91	0	0	-	-	-	-	0	0	0	0	Sufficient Capacity
4	010557STMP	008212IN	006537IN	36.221	1.5	11.5	10.35	0	0	-	-	-	-	0	0	0	0	Sufficient Capacity
4	011255STMP	008213IN	008215IN	64.126	1.25	11.5	9.53	0.5	0	1.049	-	-	-	0	0	0	0	Surcharged
4	011825STMP	008214IN	008213IN	61.646	1.25	11.5	9.27	0.5	0.5	2.225	1.049	0.175	-	0	0	0	0	Insufficient Freeboard
4	010558STMP	008215IN	008212IN	40.866	1.5	11.5	10.22	0	0	-	-	-	-	0	0	0	0	Sufficient Capacity
4	011851STMP	008225IN	008227IN	35.716	1.25	6.92	9.98	0	0	-	-	-	-	0	0	0	0	Sufficient Capacity
4	011528STMP	008227IN	004080SMH	17.952	1.25	6.93	8.63	0	0	-	0.146	-	-	0	0	0	0	Sufficient Capacity
4	011520STMP	008240IN	002675SMH	237.201	3	44.38	10.11	0	0	-	-	-	-	0	0	0	0	Sufficient Capacity
4	011915STMP	008241IN	008240IN	36.171	2.5	33.63	13.86	0	0	-	-	-	-	0	0	0	0	Sufficient Capacity
4	011918STMP	008242IN	002687SMH	17.981	2	33.63	10.69	0.3	0.5	0.518	0.62	-	-	0	0	0	0	Surcharged
4	011919STMP	008243IN	008242IN	124.591	1.75	24.87	11.1	0	0.3	0.061	0.768	-	-	0	0	0	0	Surcharged
4	011921STMP	008244IN	008243IN	26.146	1.25	7.21	5.86	0.1	0	0.449	0.561	-	-	0	0	0	0	Surcharged
4	011920STMP	008246IN	008243IN	81.413	1.75	17.96	8.87	0	0	-	0.061	-	-	0	0	0	0	Sufficient Capacity
4	009674STMP	008248IN	002688SMH	53.813	1.5	12.01	8.83	0.2	0.5	0.361	1.471	-	-	0	0	0	0	Surcharged
4	011140STMP	008252IN	002689SMH	29.102	1.5	12.08	6.78	0.5	0.6	2.144	2.348	0.826	0.942	0	0	0	0	Insufficient Freeboard
4	011142STMP	008259IN	008252IN	114.005	1.5	12.01	6.71	0.6	0.5	Flooded	2.144	Flooded	0.826	0.39166667	0	902.88	0	Flooded
4	010889STMP	008275IN	008276IN	202.27	1.5	-5.99	3.35	0.8	0.5	3.201	1.25	0.049	-	0	0	0	0	Insufficient Freeboard
4	010888STMP	008276IN	008277IN	259.41	1.5	5.97	4.55	0.5	1	1.25	Flooded	-	Flooded	0	0.79833333	0	5226.7	Surcharged
4	010887STMP	008277IN	008278IN	209.218	1.5	9.7	5.37	1	0.8	Flooded	1.958	Flooded	-	0.79833333	0	5226.7	0	Flooded
4	012184STMP	008278IN	008301IN	146.437	1.5	9.71	5.47	0.8	1.7	1.958	2.064	-	-	0	0	0	0	Surcharged
4	015313STMP	008301IN	008242IN	39.074	1.5	-9.72	5.55	1.7	0.3	2.064	1.018	-	-	0	0	0	0	Surcharged
4	011852STMP	009822IN	008225IN	90.729	1.25	6.92	7.63	0	0	-	-	-	-	0	0	0	0	Sufficient Capacity
4	015263STMP	009823IN	004080SMH	67.785	2.5	19.75	9.06	0	0	-	-	-	-	0	0	0	0	Sufficient Capacity
4	015317STMP	009071IN	004081SMH	7.864	3.5	84.23	11.87	0	0	-	-	-	-	0	0	0	0	Sufficient Capacity
4	014422STMP	009323IN	004245SMH	16.454	2.5	26.03	8.07	0	0	-	-	-	-	0	0	0	0	Sufficient Capacity
4	014429STMP	009335IN	004253SMH	49.527	2.5	17.85	6.65	0	0	-	-	-	-	0	0	0	0	Sufficient Capacity
4	014430STMP	009336IN	009335IN	24.31	2.5	17.84	7.42	0	0	-	-	-	-	0	0	0	0	Sufficient Capacity
4	014431STMP	009337IN	009336IN	23.264	2.5	17.83	7.3	0	0	-	-	-	-	0	0	0	0	Sufficient Capacity
4	015323STMP	001937SMH	002676SMH	88.299	2.5	39.75	13.96	0	0	-	-	-	-	0	0	0	0	Sufficient Capacity
4	011991STMP	001939SMH	001937SMH	60.975	3	39.74	15.23	0	0	-	-	-	-	0	0	0	0	Sufficient Capacity
4	012125STMP	002332SMH	002334SMH	180.336	1.5	2.86	4.06	0	44.5	-	1.206	-	-	0	0	0	0	Sufficient Capacity
4	012128STMP	002333SMH	008211IN	51.836	2	5.88	11	0	0	-	-	-	-	0	0	0	0	Sufficient Capacity
4	012131STMP	002334SMH	004860SMH	26.622	1.5	-2.86	1.61	44.5	0.9	1.206	0.646	-	-	0	0	0	0	Surcharged
4	011524STMP	002675SMH	002676SMH	94.377	3	44.4	15.77	0	0	-	-	-	-	0	0	0	0	Sufficient Capacity
4	011914STMP	002676SMH	009071IN	51.868	3	84.2	15.22	0	0	-	-	-	-	0	0	0	0	Sufficient Capacity
4	011917STMP	002687SMH	008241IN	17.643	2	-33.63	11.11	0.5	0	0.62	-	-	-	0	0	0	0	Surcharged
4	009673STMP	002688SMH	008246IN	57.098	1.5	17.97	10.12	0.5	0	1.471	0.123	-	-	0	0	0	0	Surcharged
4	009676STMP	002689SMH	008248IN	237.153	1.5	11.94	6.8	0.6	0.2	2.348	0.361	0.942	-	0	0	0	0	Insufficient Freeboard
4	015176STMP	004806SMH	004807SMH	148.922	4.5	96.34	13.64	0	0	-	-	-	-	0	0	0	0	Sufficient Capacity
4	012129STMP	004860SMH	007480IN	253.626	2	-4.23	1.39	0.9	0	0.256	-	-	-	0	0	0	0	Surcharged
4	015315STMP	004079SMH	009823IN	139.237	2.5	17.24	9.92	0	0	-	-	-	-	0	0	0	0	Sufficient Capacity
4	015316STMP	004080SMH	001939SMH	78.821	2.5	26.5	9.61	0	0	-	-	-	-	0	0	0	0	Sufficient Capacity
4	015322STMP	004081SMH	004806SMH	335.429	4.5	84.26	11.09	0	0	-	-	-	-	0	0	0	0	Sufficient Capacity

TABLE 1

Potomac River Detailed Hydraulic Model Results

Subshed	DGravityMain FacilityID	Junction FaciltiyID		Length (ft)	Diameter/ Height x Width (ft)	Maximum Flow (ft3/s)	Maximum Velocity (fps)	Duration of Surcharge (hrs)		Surcharge/ Depth Above Crown (ft)		Insufficient Freeboard/ Depth Below Rim (ft)		Duration of Flooding (hrs)		Flooded Volume (ft3)		Summary Pipe Condition
		US	DS					US	DS	US	DS	US	DS	US	DS	US	DS	
4	014736STMP	004233SMH	004270SMH	131.014	1.5	9.64	6.17	0	0	-	-	-	-	0	0	0	0	Sufficient Capacity
4	014715STMP	004235SMH	004237SMH	45.246	2	9.64	5.33	0	0	-	-	-	-	0	0	0	0	Sufficient Capacity
4	014718STMP	004237SMH	004238SMH	83.35	2	9.65	5.88	0	0	-	-	-	-	0	0	0	0	Sufficient Capacity
4	014719STMP	004238SMH	004239SMH	49.845	2.5	9.68	3.97	0	0	-	-	-	-	0	0	0	0	Sufficient Capacity
4	014725STMP	004239SMH	004240SMH	127.109	2.5	20.05	6.38	0	0	-	-	-	-	0	0	0	0	Sufficient Capacity
4	014726STMP	004240SMH	004241SMH	143.401	2.5	20.09	6.4	0	0	-	-	-	-	0	0	0	0	Sufficient Capacity
4	014731STMP	004241SMH	004242SMH	49.217	2.5	20.09	6.43	0	0	-	-	-	-	0	0	0	0	Sufficient Capacity
4	014732STMP	004242SMH	004246SMH	58.097	2.5	20.1	6.86	0	0	-	-	-	-	0	0	0	0	Sufficient Capacity
4	014363STMP	004243SMH	000589IO	164.725	6	151.15	8.25	0	0	-	-	-	-	0	0	0	0	Sufficient Capacity
4	014424STMP	004244SMH	004243SMH	22.277	3.5	46.53	4.88	0	0	-	0.129	-	-	0	0	0	0	Sufficient Capacity
4	014423STMP	004245SMH	004244SMH	21.196	2.5	26.04	8.37	0	0	-	-	-	-	0	0	0	0	Sufficient Capacity
4	014421STMP	004246SMH	009323IN	26.883	2.5	26.02	8.7	0	0	-	-	-	-	0	0	0	0	Sufficient Capacity
4	014417STMP	004247SMH	004246SMH	56.424	1.5	6.04	9.22	0	0	-	-	-	-	0	0	0	0	Sufficient Capacity
4	014414STMP	004248SMH	004247SMH	50.325	1.5	6.04	5.52	0	0	-	-	-	-	0	0	0	0	Sufficient Capacity
4	014362STMP	004250SMH	004243SMH	165.265	6	109.3	5.85	0	0	-	-	-	-	0	0	0	0	Sufficient Capacity
4	014360STMP	004251SMH	004250SMH	79.184	6	108.96	5.77	0	0	-	-	-	-	0	0	0	0	Sufficient Capacity
4	014442STMP	004252SMH	004254SMH	95.511	2.5	12.39	5.64	0	0	-	-	-	-	0	0	0	0	Sufficient Capacity
4	014428STMP	004253SMH	004244SMH	126.362	2.5	17.89	9.37	0	0	-	-	-	-	0	0	0	0	Sufficient Capacity
4	014432STMP	004254SMH	009337IN	33.423	2.5	17.82	8.12	0	0	-	-	-	-	0	0	0	0	Sufficient Capacity
4	014358STMP	004255SMH	004251SMH	70.653	6	108.77	5.72	0	0	-	-	-	-	0	0	0	0	Sufficient Capacity
4	014443STMP	004256SMH	004252SMH	86.381	2	12.37	7.35	0	0	-	-	-	-	0	0	0	0	Sufficient Capacity
4	014447STMP	004257SMH	004256SMH	65.327	2	7.83	5.72	0	0	-	-	-	-	0	0	0	0	Sufficient Capacity
4	014570STMP	004258SMH	004257SMH	113.951	2	7.82	5.03	0	0	-	-	-	-	0	0	0	0	Sufficient Capacity
4	014573STMP	004259SMH	004258SMH	111.389	2	7.83	5.07	0	0	-	-	-	-	0	0	0	0	Sufficient Capacity
4	014439STMP	004263SMH	004254SMH	45.172	2	3.4	6.68	0	0	-	-	-	-	0	0	0	0	Sufficient Capacity
4	014437STMP	004264SMH	004263SMH	54.694	1.5	3.4	7.74	0	0	-	-	-	-	0	0	0	0	Sufficient Capacity
4	014735STMP	004270SMH	004235SMH	23.698	1.5	9.64	7.02	0	0	-	-	-	-	0	0	0	0	Sufficient Capacity
4	015456STMP	004278SMH	004255SMH	33.796	3.5	102.04	10.15	0.3	0	0.631	0.361	-	-	0	0	0	0	Surcharged
4	012130STMP	000467IO	004860SMH	44.84	1.25	1.4	5.39	0	0.9	-	0.776	1.124	-	0	0	0	0	Sufficient Capacity
5	015286STMP	002354ND	004825SMH	319.863	4	53.66	8.06	0	0	-	-	1.93	-	0	0	0	0	Sufficient Capacity
5	014818STMP	009223IN	000020PD	47.928	2	7.02	4.75	0	0	-	0.209	-	-	0	0	0	0	Surcharged
5	014817STMP	009224IN	009223IN	28.987	1.5	2.73	3.77	0	0	-	-	-	-	0	0	0	0	Sufficient Capacity
5	014811STMP	009228IN	009224IN	111.499	1.5	2.73	3.94	0	0	-	-	-	-	0	0	0	0	Sufficient Capacity
5	014753STMP	009242IN	004175SMH	83.507	1.75	8.47	6.12	0	0	-	-	-	-	0	0	0	0	Sufficient Capacity
5	014758STMP	009255IN	000020PD	50.752	2.5	5.85	4.42	0	0	-	0.169	-	-	0	0	0	0	Sufficient Capacity
5	015331STMP	004086SMH	004087SMH	98.583	2.5	12.69	2.58	2.6	2.6	2.771	3.26	1.931	-	0	0	0	0	Insufficient Freeboard
5	015340STMP	004087SMH	004089SMH	167.674	3	12.57	1.77	2.6	2.4	2.76	3.597	-	-	0	0	0	0	Surcharged
5	014819STMP	004089SMH	004090SMH	208.724	4	23.11	1.8	2.4	4.3	2.597	3.642	-	-	0	0	0	0	Surcharged
5	014821STMP	004090SMH	000020PD	118.075	4	23.03	1.83	4.3	0	3.642	4.232	-	-	0	0	0	0	Surcharged
5	014815STMP	004173SMH	009223IN	43.009	1.5	4.28	4.49	0	0	-	-	-	-	0	0	0	0	Sufficient Capacity
5	014755STMP	004175SMH	000020PD	46.083	2.5	8.48	5.13	0	0	-	-	-	-	0	0	0	0	Sufficient Capacity
5	014752STMP	004176SMH	009242IN	40.02	1.5	8.46	6.09	0	0	-	-	-	-	0	0	0	0	Sufficient Capacity
5	014750STMP	004179SMH	004176SMH	53.864	1.5	8.47	5.51	0	0	-	-	-	-	0	0	0	0	Sufficient Capacity
5	015379STMP	004181SMH	004183SMH	40.072	4.5	85.33	7.48	0	0	-	-	-	-	0	0	0	0	Sufficient Capacity
5	014760STMP	004182SMH	000020PD	112.307	4.5	85.39	7.97	0	0	-	-	-	-	0	0	0	0	Sufficient Capacity
5	015378STMP	004183SMH	004182SMH	120.449	4.5	85.36	7.59	0	0	-	-	-	-	0	0	0	0	Sufficient Capacity
5	015421STMP	004184SMH	004181SMH	39.657	4.5	82.11	7.16	0	0	-	-	-	-	0	0	0	0	Sufficient Capacity
5	014761STMP	004185SMH	004184SMH	297.114	4.5	82.06	7.04	0	0	-	-	-	-	0	0	0	0	Sufficient Capacity

TABLE 1

Potomac River Detailed Hydraulic Model Results

Subshed	DGravityMain FacilityID	Junction FaciltiyID		Length (ft)	Diameter/ Height x Width (ft)	Maximum Flow (ft3/s)	Maximum Velocity (fps)	Duration of Surcharge (hrs)		Surcharge/ Depth Above Crown (ft)		Insufficient Freeboard/ Depth Below Rim (ft)		Duration of Flooding (hrs)		Flooded Volume (ft3)		Summary Pipe Condition
		US	DS					US	DS	US	DS	US	DS	US	DS	US	DS	
5	015389STMP	004186SMH	004185SMH	35.823	4	82	7.72	0	0	-	-	-	-	0	0	0	0	Sufficient Capacity
5	015388STMP	004187SMH	004186SMH	39.438	4	82.01	7.6	0	0	-	-	-	-	0	0	0	0	Sufficient Capacity
5	015393STMP	004188SMH	004187SMH	175.556	4	82.04	7.3	0	0	-	-	-	-	0	0	0	0	Sufficient Capacity
5	015397STMP	004189SMH	004190SMH	39.461	3	30.92	4.56	0	0	-	-	-	-	0	0	0	0	Sufficient Capacity
5	015402STMP	004190SMH	004191SMH	37.772	3	30.99	4.54	0	0	-	-	-	-	0	0	0	0	Sufficient Capacity
5	015403STMP	004191SMH	004188SMH	279.927	3.5	31.38	3.88	0	0	-	-	-	-	0	0	0	0	Sufficient Capacity
5	015405STMP	004192SMH	004189SMH	135.132	3	30.76	4.69	0	0	-	-	-	-	0	0	0	0	Sufficient Capacity
5	015410STMP	004193SMH	004194SMH	50.314	2	30.38	9.63	0.3	0.1	1.25	0.601	-	-	0	0	0	0	Surcharged
5	015411STMP	004194SMH	004195SMH	69.459	2.5	30.37	6.36	0.1	0.1	0.101	0.081	-	-	0	0	0	0	Surcharged
5	015413STMP	004195SMH	004196SMH	50.079	2.5	30.36	6.23	0.1	0	0.081	0.064	-	-	0	0	0	0	Surcharged
5	015415STMP	004196SMH	004192SMH	273.844	3	30.47	4.9	0	0	-	-	-	-	0	0	0	0	Sufficient Capacity
6	011791STMP	000020CD	000405IO	59.477	5	226.17	18.99	0	0	-	-	-	-	0	0	0	0	Sufficient Capacity
6	011783STMP	006484IN	006485IN	96.132	1.75	16.05	8.07	0	0	-	-	-	-	0	0	0	0	Sufficient Capacity
6	011785STMP	006485IN	006486IN	298.512	1.75	15.91	8.72	0	0	-	-	-	-	0	0	0	0	Sufficient Capacity
6	011425STMP	006486IN	006487IN	27.683	1.75	15.91	9.19	0	0	-	-	-	-	0	0	0	0	Sufficient Capacity
6	011427STMP	006487IN	006488IN	275.136	1.75	26.45	12.37	0	0	-	-	-	-	0	0	0	0	Sufficient Capacity
6	011428STMP	006488IN	001880SMH	35.389	1.75	26.46	14.17	0	0	-	-	-	-	0	0	0	0	Sufficient Capacity
6	012158STMP	006502IN	000017PD	52.869	4.5	188.67	11.78	39.8	45.5	4.943	4.998	-	0.952	0	0	0	0	Surcharged
6	011802STMP	006520IN	001897SMH	33.303	1.5	7.98	5.71	0.1	0.2	2.154	2.587	-	-	0	0	0	0	Surcharged
6	011803STMP	006523IN	006520IN	272.552	1.25	7.89	8.83	0	0.1	-	2.404	-	-	0	0	0	0	Sufficient Capacity
6	007953STMP	007172IN	007213IN	136.929	1.5	9.38	5.68	0.4	0.5	Flooded	2.41	Flooded	-	0.42	0	1888.36	0	Flooded
6	007812STMP	007175IN	007182IN	317.836	1.25	9.34	7.38	0.6	0.5	6.566	1.468	0.314	-	0	0	0	0	Insufficient Freeboard
6	007834STMP	007182IN	007184IN	108.745	1.25	9.33	7.55	0.5	0.5	1.468	0.309	-	-	0	0	0	0	Surcharged
6	007835STMP	007184IN	007185IN	23.032	1.25	9.33	7.59	0.5	0	0.309	-	-	-	0	0	0	0	Surcharged
6	007836STMP	007185IN	002443SMH	94.953	1.5	9.33	6.56	0	0	-	-	-	-	0	0	0	0	Sufficient Capacity
6	007841STMP	007189IN	002448SMH	12.359	2	-21.33	6.73	0.5	0.5	2.749	1.696	0.651	0.304	0	0	0	0	Insufficient Freeboard
6	007852STMP	007195IN	002450SMH	98.384	2	21.33	6.75	0.5	0.6	1.79	Flooded	0.21	Flooded	0	0.14666667	0	79.39	Insufficient Freeboard
6	007939STMP	007197IN	002449SMH	45.791	1.5	-5.7	3.21	0.6	0.5	1.973	1.66	0.637	1.3	0	0	0	0	Insufficient Freeboard
6	007941STMP	007198IN	007197IN	75.633	1.5	5.69	4.64	0.4	0.6	0.943	1.973	0.767	0.637	0	0	0	0	Insufficient Freeboard
6	007943STMP	007203IN	002452SMH	21.313	2	-29	9.19	0.6	0.5	1.351	0.632	1.049	1.598	0	0	0	0	Insufficient Freeboard
6	007949STMP	007209IN	002451SMH	38.555	1.25	6.44	5.22	0.4	0.5	Flooded	1.375	Flooded	0.125	0.37166667	0	1147.64	0	Flooded
6	007847STMP	007212IN	002447SMH	45.762	1.25	5.74	4.62	0.5	0.5	2.772	2.481	0.178	1.269	0	0	0	0	Insufficient Freeboard
6	007954STMP	007213IN	002447SMH	72.108	1.75	9.81	4.29	0.5	0.5	2.16	2.981	-	1.269	0	0	0	0	Surcharged
6	007848STMP	007214IN	007212IN	29.681	1.25	5.75	5.25	0.5	0.5	Flooded	2.772	Flooded	0.178	0.41833333	0	1443.85	0	Flooded
6	010115A	007801IN	000864ND	41.508	1.25	10.64	8.56	0.4	0.3	Flooded	1.68	Flooded	0.04	0.065	0	39.33	0	Flooded
6	010117STMP	007803IN	003053SMH	23.714	1.25	10.53	8.54	0.2	0.3	0.971	1.093	0.879	1.657	0	0	0	0	Insufficient Freeboard
6	007960A	007813IN	000877ND	93.363	2.5	13.14	2.98	0	0	-	-	-	-	0	0	0	0	Sufficient Capacity
6	009592STMP	007816IN	003055SMH	139.606	2.5	13.13	7.25	0	0	-	-	-	-	0	0	0	0	Sufficient Capacity
6	009597STMP	007817IN	007816IN	162.425	2.5	13.19	5.55	0	0	-	-	-	-	0	0	0	0	Sufficient Capacity
6	009595STMP	007818IN	007817IN	7.4	2.5	13.18	6.05	0	0	-	-	-	-	0	0	0	0	Sufficient Capacity
6	009678STMP	007821IN	000545IO	39.173	2.5	-20.16	4.26	0.1	0	0.04	-	-	0.472	0	0	0	0	Surcharged
6	009684STMP	007824IN	007825IN	234.903	2.5	10.33	2.87	0	0.1	-	0.093	1.272	1.907	0	0	0	0	Sufficient Capacity
6	009677STMP	007825IN	003056SMH	110.529	2.5	20.4	4.15	0.1	0	0.093	-	1.907	-	0	0	0	0	Insufficient Freeboard
6	006968STMP	001477SMH	002329SMH	74.956	4	32.34	6.72	0	0	-	-	-	-	0	0	0	0	Sufficient Capacity
6	011521STMP	001478SMH	001900SMH	221.633	4	92.72	8.79	0	0	-	-	-	-	0	0	0	0	Sufficient Capacity
6	010115B	000864ND	007803IN	33.241	1.25	10.55	8.53	0.3	0.2	1.68	0.971	0.04	0.879	0	0	0	0	Insufficient Freeboard
6	009591B	000872ND	007813IN	59.145	2.5	13.07	3.84	0	0	-	-	-	-	0	0	0	0	Sufficient Capacity
6	007960B	000877ND	002455SMH	197.1	2.5	28.62	6.01	0	0	-	-	-	-	0	0	0	0	Sufficient Capacity

TABLE 1

Potomac River Detailed Hydraulic Model Results

Subshed	DGravityMain FacilityID	Junction FaciltiyID		Length (ft)	Diameter/ Height x Width (ft)	Maximum Flow (ft3/s)	Maximum Velocity (fps)	Duration of Surcharge (hrs)		Surcharge/ Depth Above Crown (ft)		Insufficient Freeboard/ Depth Below Rim (ft)		Duration of Flooding (hrs)		Flooded Volume (ft3)		Summary Pipe Condition
		US	DS					US	DS	US	DS	US	DS	US	DS	US	DS	
6	012154B	001104ND	001107ND	86.351	4	132.15	14.26	0	0	-	-	-	-	0	0	0	0	Sufficient Capacity
6	012154C	001107ND	001108ND	120.316	4	132.23	13.88	0	0	-	-	-	-	0	0	0	0	Sufficient Capacity
6	012154D	001108ND	001109ND	45.612	4	144.29	14.18	0	0	-	-	-	-	0	0	0	0	Sufficient Capacity
6	012154E	001109ND	001895SMH	163.357	4	144.4	13.89	0	0	-	-	-	-	0	0	0	0	Sufficient Capacity
6	012180STMP	001123ND	000409IO	59.791	2	46.26	14.78	0.1	0	1.739	-	-	-	0	0	0	0	Surcharged
6	011591B	001397ND	001478SMH	32.859	4	57.8	5.56	0	0	-	-	-	-	0	0	0	0	Sufficient Capacity
6	015220STMP	0023401ND	004845SMH	138.209	3.5	34.66	8.12	0	0	-	-	-	-	0	0	0	0	Sufficient Capacity
6	014831STMP	0023400ND	001123ND	1114.293	3.5	46.48	8.1	0	0.1	-	0.239	-	-	0	0	0	0	Sufficient Capacity
6	011819STMP	008201IN	008210IN	215.739	1.75	-9.68	4.26	0.2	0	1.049	-	-	-	0	0	0	0	Surcharged
6	010554STMP	008210IN	001891SMH	187.479	1.75	9.67	8.61	0	0	-	1.305	-	-	0	0	0	0	Sufficient Capacity
6	012183STMP	008282IN	008286IN	42.23	2.5	-23.13	6.07	0	0	0.541	-	-	-	0	0	0	0	Surcharged
6	011999STMP	008283IN	008282IN	93.797	2.5	23.12	5.45	0	0	-	0.541	-	-	0	0	0	0	Sufficient Capacity
6	012182STMP	008286IN	000017PD	76.647	2.5	38.86	7.82	0	45.5	4.626	5.278	-	0.952	0	0	0	0	Surcharged
6	011429STMP	001880SMH	000404IO	81.399	1.75	26.46	20.92	0	0	-	-	-	1.089	0	0	0	0	Sufficient Capacity
6	012157STMP	001885SMH	006502IN	42.256	4.5	188.67	11.78	35.2	39.8	4.846	4.943	-	-	0	0	0	0	Surcharged
6	011792STMP	001886SMH	001890SMH	204.522	4	124.27	13.48	0	0	-	-	-	-	0	0	0	0	Sufficient Capacity
6	011793STMP	001887SMH	001886SMH	64.45	4	124.22	14.48	0	0	-	-	-	-	0	0	0	0	Sufficient Capacity
6	011896STMP	001890SMH	001893SMH	112.035	4	132.06	13.95	0	0	-	-	-	-	0	0	0	0	Sufficient Capacity
6	011795STMP	001891SMH	001887SMH	222.323	4	113.33	11.21	0	0	-	-	-	-	0	0	0	0	Sufficient Capacity
6	012149STMP	001892SMH	001891SMH	75.513	4	103.75	9.72	0	0	-	-	-	-	0	0	0	0	Sufficient Capacity
6	012153STMP	001893SMH	001894SMH	71.09	4	132.09	12.45	0	0	-	-	-	-	0	0	0	0	Sufficient Capacity
6	012154A	001894SMH	001104ND	150.103	4	132.12	14.49	0	0	-	-	-	-	0	0	0	0	Sufficient Capacity
6	011910STMP	001895SMH	001896SMH	161.429	4	144.58	12.51	0	0	-	4.697	-	-	0	0	0	0	Sufficient Capacity
6	012156STMP	001896SMH	001885SMH	78.12	4	162.15	12.81	0	35.2	4.697	4.846	-	-	0	0	0	0	Surcharged
6	011801STMP	001897SMH	001896SMH	198.049	1.5	19.04	10.67	0.2	0	2.587	-	-	-	0	0	0	0	Surcharged
6	011807STMP	001898SMH	006523IN	129.514	1.25	8.09	8.17	0	0	-	-	-	-	0	0	0	0	Sufficient Capacity
6	011824STMP	001900SMH	001901SMH	88.585	4	103.55	10.19	0	0	-	-	-	-	0	0	0	0	Sufficient Capacity
6	010547STMP	001901SMH	001902SMH	101.314	4	103.58	9.67	0	0	-	-	-	-	0	0	0	0	Sufficient Capacity
6	015240STMP	001902SMH	001892SMH	237.612	4	103.66	9.51	0	0	-	-	-	-	0	0	0	0	Sufficient Capacity
6	011934STMP	001921SMH	008286IN	71.899	2.5	15.74	5.58	0	0	-	-	-	-	0	0	0	0	Sufficient Capacity
6	011935STMP	001922SMH	001921SMH	138.201	2.5	15.73	6.54	0	0	-	-	-	-	0	0	0	0	Sufficient Capacity
6	012163STMP	001923SMH	001922SMH	60.656	1.75	5.61	7.48	0	0	-	-	-	-	0	0	0	0	Sufficient Capacity
6	012170STMP	001925SMH	001926SMH	105.306	2	13.5	6.31	0	0	-	-	-	-	0	0	0	0	Sufficient Capacity
6	012174STMP	001926SMH	001928SMH	46.835	2	13.47	6.29	0	0	-	-	-	-	0	0	0	0	Sufficient Capacity
6	012173STMP	001927SMH	008283IN	143.791	2.5	13.5	8.23	0	0	-	-	-	-	0	0	0	0	Sufficient Capacity
6	011996STMP	001928SMH	001927SMH	46.372	2	13.48	5.31	0	0	-	-	-	-	0	0	0	0	Sufficient Capacity
6	011591A	002326SMH	001397ND	50.35	4	57.78	5.77	0	0	-	-	-	-	0	0	0	0	Sufficient Capacity
6	011602STMP	002329SMH	002330SMH	90.656	4	48.59	7.58	0	0	-	-	-	-	0	0	0	0	Sufficient Capacity
6	012123STMP	002330SMH	002331SMH	158.754	4	48.61	7.58	0	0	-	-	-	-	0	0	0	0	Sufficient Capacity
6	011592STMP	002331SMH	002326SMH	84.973	4	57.76	6.61	0	0	-	-	-	-	0	0	0	0	Sufficient Capacity
6	012118STMP	002443SMH	002329SMH	64.803	2	16.78	12.09	0	0	-	0.039	-	-	0	0	0	0	Sufficient Capacity
6	007840STMP	002444SMH	007189IN	91.036	2	16.16	5.13	0.5	0.5	2.295	2.349	1.205	0.651	0	0	0	0	Insufficient Freeboard
6	007843STMP	002445SMH	002444SMH	52.861	2	15.67	4.97	0.5	0.5	2.313	2.295	1.687	1.205	0	0	0	0	Insufficient Freeboard
6	007845STMP	002447SMH	002445SMH	68.789	2	-15.46	4.89	0.5	0.5	2.731	2.313	1.269	1.687	0	0	0	0	Insufficient Freeboard
6	007850STMP	002448SMH	007195IN	61.93	2	21.33	6.95	0.5	0.5	1.696	1.79	0.304	0.21	0	0	0	0	Insufficient Freeboard
6	007940STMP	002449SMH	002450SMH	20.488	1.5	5.73	3.99	0.5	0.6	1.66	Flooded	1.3	Flooded	0	0.14666667	0	79.39	Insufficient Freeboard
6	007955STMP	002450SMH	007203IN	105.931	2	24.48	7.74	0.6	0.6	Flooded	1.351	Flooded	1.049	0.14666667	0	79.39	0	Flooded
6	007952STMP	002451SMH	002452SMH	141.07	1.25	6.41	5.19	0.5	0.5	1.375	1.382	0.125	1.598	0	0	0	0	Insufficient Freeboard

TABLE 1

Potomac River Detailed Hydraulic Model Results

Subshed	DGravityMain FacilityID	Junction FaciltiyID		Length (ft)	Diameter/ Height x Width (ft)	Maximum Flow (ft3/s)	Maximum Velocity (fps)	Duration of Surcharge (hrs)		Surcharge/ Depth Above Crown (ft)		Insufficient Freeboard/ Depth Below Rim (ft)		Duration of Flooding (hrs)		Flooded Volume (ft3)		Summary Pipe Condition
		US	DS					US	DS	US	DS	US	DS	US	DS	US	DS	
6	007947STMP	002452SMH	004859SMH	38.595	2	-34.96	11.65	0.5	0	0.632	-	1.598	-	0	0	0	0	Insufficient Freeboard
6	006969STMP	002455SMH	001477SMH	221.01	4	32.33	4.92	0	0	-	-	-	-	0	0	0	0	Sufficient Capacity
6	010893STMP	002694SMH	004268SMH	215.235	3.5	46.25	11.47	0	0	-	-	-	-	0	0	0	0	Sufficient Capacity
6	009478STMP	003053SMH	003054SMH	51.924	1.5	-10.39	5.84	0.3	0	0.843	0.21	1.657	-	0	0	0	0	Insufficient Freeboard
6	009582STMP	003054SMH	007824IN	117	2.5	10.32	3.05	0	0	-	-	-	1.272	0	0	0	0	Sufficient Capacity
6	009591A	003055SMH	000872ND	76.838	2.5	13.07	4.72	0	0	-	-	-	-	0	0	0	0	Sufficient Capacity
6	009599STMP	003056SMH	007821IN	126.773	2.5	20.26	4.57	0	0.1	-	0.04	-	-	0	0	0	0	Sufficient Capacity
6	015219STMP	004845SMH	0023400ND	121.926	3.5	34.57	7.54	0	0	-	-	-	-	0	0	0	0	Sufficient Capacity
6	015253STMP	004114SMH	001925SMH	36.789	1.5	13.54	12.19	0	0	-	-	-	-	0	0	0	0	Sufficient Capacity
6	015259STMP	004111SMH	001922SMH	153.567	2	10.09	5.14	0	0	-	-	-	-	0	0	0	0	Sufficient Capacity
6	015258STMP	004112SMH	004111SMH	36.322	2	10.12	5.44	0	0	-	-	-	-	0	0	0	0	Sufficient Capacity
6	007956STMP	004859SMH	001478SMH	154.128	2.5	34.96	15.51	0	0	-	0.658	-	-	0	0	0	0	Sufficient Capacity
6	011998STMP	004021SMH	002694SMH	209.036	3.5	46.23	13.88	0	0	-	-	-	-	0	0	0	0	Sufficient Capacity
6	014766STMP	004199SMH	004219SMH	415.092	3	23.68	7.54	0	0	-	-	-	-	0	0	0	0	Sufficient Capacity
6	015377STMP	004219SMH	004220SMH	394.75	3.5	23.69	7.28	0	0	-	-	-	-	0	0	0	0	Sufficient Capacity
6	015092STMP	004220SMH	0023401ND	410.361	3.5	34.68	8.36	0	0	-	-	-	-	0	0	0	0	Sufficient Capacity
6	014354STMP	004268SMH	004269SMH	48.016	3.5	46.25	12.05	0	0	-	-	-	-	0	0	0	0	Sufficient Capacity
6	014356STMP	004269SMH	000591IO	78.459	6.5	46.26	4.78	0	0	-	-	-	-	0	0	0	0	Sufficient Capacity
6	012179STMP	000412IO	004021SMH	142.852	3.5	46.24	7.02	0	0	-	-	-	-	0	0	0	0	Sufficient Capacity
7	007072STMP	005133IN	002374SMH	20.362	1.25	13.37	12.46	0	0	-	-	-	-	0	0	0	0	Sufficient Capacity
7	008149STMP	005136IN	005137IN	122.535	1.25	2.24	5.5	0	0	-	-	-	-	0	0	0	0	Sufficient Capacity
7	008150STMP	005137IN	002379SMH	15.442	1.25	2.24	8.18	0	0	-	-	-	-	0	0	0	0	Sufficient Capacity
7	008151STMP	005138IN	002379SMH	110.161	1.25	5.67	4.69	0.2	0	0.456	-	-	-	0	0	0	0	Surcharged
7	008155STMP	005141IN	000471IO	166.255	3	56.39	8.19	0	0	-	-	-	-	0	0	0	0	Sufficient Capacity
7	008158STMP	005143IN	005146IN	46.83	1.25	13.11	10.62	0.2	0	1.126	-	-	-	0	0	0	0	Surcharged
7	007084STMP	005144IN	005146IN	131.398	1.5	16.21	10.44	0	0	-	-	-	-	0	0	0	0	Sufficient Capacity
7	007085STMP	005145IN	005144IN	147.714	1.5	16.25	11.15	0	0	-	-	-	-	0	0	0	0	Sufficient Capacity
7	008160STMP	005146IN	002380SMH	197.19	3	48.44	7.2	0	0	-	-	-	-	0	0	0	0	Sufficient Capacity
7	007645STMP	005152IN	005153IN	78.771	1.5	16.31	10.33	0.3	0.5	0.946	2.33	0.054	0.67	0	0	0	0	Insufficient Freeboard
7	007060STMP	005153IN	002360SMH	90.101	1.5	16.25	9.12	0.5	19.2	2.33	Flooded	0.67	Flooded	0	0.71	0	10000.63	Insufficient Freeboard
7	008161STMP	005162IN	002382SMH	95.624	1.25	10.99	9.04	3.3	0	Flooded	-	Flooded	-	0.29166667	0	363.99	0	Flooded
7	014273STMP	005163IN	005162IN	78.55	1.25	5.57	11	0	3.3	-	Flooded	1.277	Flooded	0	0.29166667	0	363.99	Sufficient Capacity
7	007618STMP	005188IN	002346SMH	51.809	1.25	0	0	0	54.5	-	1.401	-	-	0	0	0	0	Sufficient Capacity
7	007672STMP	005253IN	002353SMH	108.981	1.5	17.1	9.62	0.2	55.1	1.022	5.918	-	-	0	0	0	0	Surcharged
7	007180STMP	007252IN	002471SMH	28.09	2	19.11	15.85	0	0	-	-	-	-	0	0	0	0	Sufficient Capacity
7	008207STMP	007253IN	002493SMH	69.089	1.5	15.57	11.76	0	0	-	-	-	-	0	0	0	0	Sufficient Capacity
7	014277STMP	0001062ND	002365SMH	164.612	1.25	0	0	0	0	-	-	-	-	0	0	0	0	Sufficient Capacity
7	007631STMP	001019ND	002352SMH	100.116	2.5	27.69	11.75	0	0	-	-	-	-	0	0	0	0	Sufficient Capacity
7	015245STMP	002078ND	002385SMH	66.004	0.833	7.15	12.47	2.7	2.6	Flooded	1.777	Flooded	-	2.23666667	0	1965.72	0	Flooded
7	015265STMP	009824IN	004115SMH	62.117	2.25	-7.4	2.05	2.4	2.4	5.009	4.706	0.241	0.444	0	0	0	0	Insufficient Freeboard
7	014279STMP	002346SMH	007253IN	221.76	1.25	0.04	-0.95	54.5	0	1.901	-	-	-	0	0	0	0	Surcharged
7	007624STMP	002349SMH	002350SMH	13.205	1.75	17.11	15.83	0	0	-	-	-	-	0	0	0	0	Sufficient Capacity
7	007626STMP	002350SMH	002351SMH	40.689	2	27.67	12.14	0	0	-	-	-	-	0	0	0	0	Sufficient Capacity
7	007627STMP	002351SMH	001019ND	161.59	2	27.67	12.86	0	0	-	-	-	-	0	0	0	0	Sufficient Capacity
7	007628STMP	002352SMH	000469IO	265.983	2.5	36.8	8.22	0	18	-	Flooded	-	Flooded	0	0	0	0.64	Sufficient Capacity
7	014275STMP	002353SMH	002349SMH	68.771	1.75	-17.11	7.38	55.1	0	5.668	-	-	-	0	0	0	0	Surcharged
7	007640STMP	002358SMH	005152IN	83.202	1.25	16.33	13.04	0.4	0.3	Flooded	1.196	Flooded	0.054	0.29833333	0	1553.01	0	Flooded
7	007059STMP	002360SMH	000470IO	14.009	1.75	32.62	13.47	19.2	33.8	Flooded	Flooded	Flooded	Flooded	0.71	0	10000.63	0.54	Flooded

TABLE 1

Potomac River Detailed Hydraulic Model Results

Subshed	DGravityMain FacilityID	Junction FaciltiyID		Length (ft)	Diameter/ Height x Width (ft)	Maximum Flow (ft3/s)	Maximum Velocity (fps)	Duration of Surcharge (hrs)		Surcharge/ Depth Above Crown (ft)		Insufficient Freeboard/ Depth Below Rim (ft)		Duration of Flooding (hrs)		Flooded Volume (ft3)		Summary Pipe Condition
		US	DS					US	DS	US	DS	US	DS	US	DS	US	DS	
7	007061STMP	002362SMH	002360SMH	246.411	1.75	25.84	10.64	0.2	19.2	2.856	Flooded	-	Flooded	0	0.71	0	10000.63	Surcharged
7	007341STMP	002365SMH	002362SMH	84.875	1.5	21.02	18.17	0	0.2	-	3.106	-	-	0	0	0	0	Sufficient Capacity
7	007073STMP	002374SMH	002375SMH	23.126	1.25	13.39	14.37	0	0	-	-	-	-	0	0	0	0	Sufficient Capacity
7	007074STMP	002375SMH	002376SMH	26.441	1.25	13.38	22.59	0	0	-	0.695	-	-	0	0	0	0	Sufficient Capacity
7	007075STMP	002376SMH	002381SMH	67.61	1.25	13.33	11.04	0	0	0.695	0.157	-	-	0	0	0	0	Surcharged
7	007083STMP	002379SMH	005141IN	94.677	3	56.3	12.3	0	0	-	-	-	-	0	0	0	0	Sufficient Capacity
7	008152STMP	002380SMH	002379SMH	10.847	3	48.45	7.99	0	0	-	-	-	-	0	0	0	0	Sufficient Capacity
7	008157STMP	002381SMH	005143IN	21.699	1.25	13.11	13.13	0	0.2	0.157	1.126	-	-	0	0	0	0	Surcharged
7	008159STMP	002382SMH	005146IN	52.331	1.5	19.35	13.85	0	0	-	-	-	-	0	0	0	0	Sufficient Capacity
7	007090STMP	002385SMH	002386SMH	11.179	1.5	-7.14	4.02	2.6	2.4	1.11	0.663	-	-	0	0	0	0	Surcharged
7	007091STMP	002386SMH	002388SMH	30.681	1.5	7.13	5.92	2.4	2.6	0.663	0.915	-	0.185	0	0	0	0	Surcharged
7	007095STMP	002388SMH	002389SMH	74.248	1.25	7.12	6.46	2.6	3	1.165	Flooded	0.185	Flooded	0	2.91166667	0	4780.15	Insufficient Freeboard
7	007673STMP	002389SMH	002390SMH	80.373	1.25	6.18	5.61	3	3.2	Flooded	Flooded	Flooded	Flooded	2.91166667	2.98	4780.15	3141.24	Flooded
7	007099STMP	002390SMH	002391SMH	72.397	1.25	6.18	4.98	3.2	3.1	Flooded	Flooded	Flooded	Flooded	2.98	0.56333333	3141.24	400.94	Flooded
7	007102STMP	002391SMH	002392SMH	41.453	1	6.68	8.39	3.1	3.3	Flooded	Flooded	Flooded	Flooded	0.56333333	0.71166667	400.94	2868.6	Flooded
7	008165STMP	002392SMH	005162IN	92.341	1.25	8.2	6.6	3.3	3.3	Flooded	Flooded	Flooded	Flooded	0.71166667	0.29166667	2868.6	363.99	Flooded
7	007671STMP	002395SMH	005253IN	105.914	1.5	17.09	9.58	0.2	0.2	2.481	1.022	-	-	0	0	0	0	Surcharged
7	007986STMP	002472SMH	000480IO	119.143	3	-32.35	-4.81	24.1	39	0.962	Flooded	-	Flooded	0	0	0	1.49	Surcharged
7	007995STMP	002473SMH	002476SMH	21.355	2.5	11.98	11.46	0	0	-	-	-	-	0	0	0	0	Sufficient Capacity
7	007185STMP	002474SMH	002473SMH	44.36	2.5	11.98	10.97	0	0	-	-	-	-	0	0	0	0	Sufficient Capacity
7	007997STMP	002476SMH	002477SMH	67.827	2.5	24.67	5.6	0	20.8	-	1.436	-	-	0	0	0	0	Sufficient Capacity
7	008000STMP	002477SMH	002472SMH	95.798	3	24.7	-4.44	20.8	24.1	0.936	0.962	-	-	0	0	0	0	Surcharged
7	007987STMP	002493SMH	007252IN	96.303	2	15.57	7.59	0	0	-	-	-	-	0	0	0	0	Sufficient Capacity
7	015244STMP	004115SMH	002078ND	124.988	2.25	7.55	3.42	2.4	2.7	4.706	Flooded	0.444	Flooded	0	2.23666667	0	1965.72	Insufficient Freeboard
7	015283STMP	002471SMH	000481IO	152.358	2	19.12	6.42	0	0	-	-	-	0.528	0	0	0	0	Sufficient Capacity
8	008265STMP	000383CB	005300IN	41.919	1.25	3.08	4.66	1.1	1.1	Flooded	Flooded	Flooded	Flooded	0.26166667	0.195	257.43	63.6	Flooded
8	007173STMP	005173IN	002469SMH	36.658	1.5	11.88	12.27	0.7	0.7	Flooded	Flooded	Flooded	Flooded	0.53333333	0.58166667	2620.68	3055.73	Flooded
8	008264STMP	005300IN	002504SMH	17.405	1.5	11.79	6.54	1.1	1.3	Flooded	Flooded	Flooded	Flooded	0.195	0.79333333	63.6	2769.79	Flooded
8	007363STMP	005304IN	002970SMH	34.339	1	-6.15	-7.74	72	72	Flooded	Flooded	Flooded	Flooded	2.34666667	0.57166667	6972.8	254.08	Flooded
8	007441STMP	005321IN	002977SMH	4.895	1.5	9.67	10.01	0	0	-	-	-	-	0	0	0	0	Sufficient Capacity
8	007444A	005322IN	0001093ND	127.85	1.5	9.67	11.31	0	0	-	-	-	-	0	0	0	0	Sufficient Capacity
8	007691STMP	005328IN	002979SMH	52.507	2.5	-25.47	6.27	49.8	0	2.166	-	-	-	0	0	0	0	Surcharged
8	007695STMP	005332IN	002987SMH	178.496	1.75	10.92	4.9	0	0.5	0.049	1.081	1.539	-	0	0	0	0	Insufficient Freeboard
8	008004STMP	005335IN	005332IN	37.784	1.25	10.81	8.76	0.2	0	1.191	0.549	-	1.539	0	0	0	0	Surcharged
8	007865STMP	005336IN	005335IN	66.983	1.25	10.85	8.62	0.5	0.2	Flooded	1.191	Flooded	-	0.05833333	0	21.19	0	Flooded
8	008008STMP	005337IN	002985SMH	173.674	2	14.79	7.22	0	0	-	-	1.905	-	0	0	0	0	Sufficient Capacity
8	008014STMP	005341IN	002989SMH	90.942	1.5	10.93	6.16	0.2	0.4	0.896	1.191	0.154	-	0	0	0	0	Insufficient Freeboard
8	007434STMP	005344IN	002994SMH	6.158	1.75	7.79	4.23	0	0	-	-	-	-	0	0	0	0	Sufficient Capacity
8	007450STMP	005351IN	002984SMH	227.854	3	16.53	4.25	0	0	-	-	1.683	-	0	0	0	0	Sufficient Capacity
8	007451STMP	005353IN	005355IN	146.455	2	7.95	4.31	0.3	22.7	0.504	1.33	-	-	0	0	0	0	Surcharged
8	008041STMP	005355IN	003006SMH	32.025	2	-17.63	-6.14	22.7	23.1	1.33	1.601	-	-	0	0	0	0	Surcharged
8	008007STMP	005396IN	005336IN	131.749	1.25	11.24	12.58	0	0.5	-	Flooded	-	Flooded	0	0.05833333	0	21.19	Sufficient Capacity
8	008212STMP	007280IN	002495SMH	30.218	1.25	-5.67	4.6	0.7	0.7	2.31	2.215	0.35	0.345	0	0	0	0	Insufficient Freeboard
8	008250STMP	007290IN	002500SMH	43.304	1.5	24.79	13.91	0.3	0	1.385	0.098	0.615	-	0	0	0	0	Insufficient Freeboard
8	008258STMP	007291IN	000483IO	32.318	2	24.89	9.65	0	28.1	-	1.028	-	1.972	0	0	0	0	Sufficient Capacity
8	008262STMP	007292IN	002504SMH	19.086	1.25	6.54	6.28	1.1	1.3	Flooded	Flooded	Flooded	Flooded	0.85	0.79333333	3472.15	2769.79	Flooded
8	007674STMP	007294IN	000484IO	92.239	1.25	10.96	8.79	27.1	43.1	3.445	1.979	1.503	-	0	0	0	0	Insufficient Freeboard
8	007790B	0001072ND	002936SMH	86.073	1.25	9.08	7.28	45.1	51.9	3.494	Flooded	0.575	Flooded	0	5.405	0	9680.98	Insufficient Freeboard

TABLE 1

Potomac River Detailed Hydraulic Model Results

		Junction FaciltiyID						Duration of Surcharge (hrs)		Surcharge/ Depth Above Crown (ft)		Insufficient Freeboard/ Depth Below Rim (ft)		Duration of Flooding (hrs)		Flooded Volume (ft3)		
Subshed	DGravityMain FacilityID	US	DS	Length (ft)	Diameter/ Height x Width (ft)	Maximum Flow (ft3/s)	Maximum Velocity (fps)	US	DS	US	DS	US	DS	US	DS	US	DS	Summary Pipe Condition
8	007805STMP	0001080ND	002958SMH	293.01	1.25	9.12	9.69	0	1.8	-	Flooded	-	Flooded	0	0.635	0	3881.23	Sufficient Capacity
8	014318STMP	0001090ND	002973SMH	157.648	1	4.26	5.27	16.7	72	Flooded	Flooded	Flooded	Flooded	1.48666667	2.86833333	16.21	5349.23	Flooded
8	007809B	0001091ND	002952SMH	23.434	1	8.85	13.01	0.6	0.7	Flooded	Flooded	Flooded	Flooded	0.50166667	0.57833333	9.57	3106.71	Flooded
8	007444B	0001093ND	005321IN	5.453	1.5	9.68	7.62	0	0	-	-	-	-	0	0	0	0	Sufficient Capacity
8	007172STMP	002397SMH	002467SMH	249.79	1.5	14.35	9.99	0	0.7	-	3.061	-	0.139	0	0	0	0	Sufficient Capacity
8	007766STMP	002398SMH	002399SMH	34.8	1.25	8.87	16.44	0	0	-	-	-	-	0	0	0	0	Sufficient Capacity
8	007370STMP	002399SMH	002955SMH	280.723	1.25	8.86	10.25	0	1.4	-	Flooded	-	Flooded	0	0.79833333	0	7411.11	Sufficient Capacity
8	014291STMP	002461SMH	004275SMH	66.502	1.5	15.86	8.86	0.8	0.8	3.177	2.128	1.73	-	0	0	0	0	Insufficient Freeboard
8	007171STMP	002467SMH	005173IN	47.083	1.5	14.34	8.26	0.7	0.7	3.061	Flooded	0.139	Flooded	0	0.53333333	0	2620.68	Insufficient Freeboard
8	007175STMP	002469SMH	002479SMH	304.955	1.5	18.23	10.02	0.7	28	Flooded	Flooded	Flooded	Flooded	0.58166667	1.19	3055.73	8421.61	Flooded
8	007878STMP	002479SMH	002481SMH	81.886	1.5	11.52	6.35	28	66	Flooded	Flooded	Flooded	Flooded	1.19	1.2	8421.61	6085.35	Flooded
8	007882STMP	002480SMH	002481SMH	54.875	1.5	11.01	6.08	36.2	66	Flooded	Flooded	Flooded	Flooded	0.91166667	1.2	2664.47	6085.35	Flooded
8	007883STMP	002481SMH	000479IO	151.665	1.5	17.72	9.74	66	72	Flooded	6.704	Flooded	0.052	1.2	0	6085.35	0	Flooded
8	007148STMP	002483SMH	002461SMH	106.882	1.5	15.86	8.8	0.8	0.8	Flooded	3.177	Flooded	1.73	0.74833333	0	4710.61	0	Flooded
8	007887STMP	002484SMH	002483SMH	66.778	1.25	9.36	7.47	0.8	0.8	Flooded	Flooded	Flooded	Flooded	0.41333333	0.74833333	430.64	4710.61	Flooded
8	007889STMP	002485SMH	002484SMH	72.695	1.25	9.41	7.5	0.8	0.8	Flooded	Flooded	Flooded	Flooded	0.58833333	0.41333333	3288.02	430.64	Flooded
8	007890STMP	002486SMH	002485SMH	162.195	1.25	11.61	9.09	0.8	0.8	Flooded	Flooded	Flooded	Flooded	0.36166667	0.58833333	1100.97	3288.02	Flooded
8	008208STMP	002494SMH	002495SMH	12.274	1.25	7.92	6.39	0.6	0.7	Flooded	2.215	Flooded	0.345	0.30166667	0	662.42	0	Flooded
8	008211STMP	002495SMH	002501SMH	101.836	1.25	11.32	9.15	0.7	0.2	2.215	0.805	0.345	0.955	0	0	0	0	Insufficient Freeboard
8	008209STMP	002496SMH	002494SMH	67.091	1.25	11.89	9.55	0.5	0.6	3.018	Flooded	0.052	Flooded	0	0.30166667	0	662.42	Insufficient Freeboard
8	008256STMP	002500SMH	007291IN	44.939	1.5	24.86	14.59	0	0	0.098	0.005	-	-	0	0	0	0	Surcharged
8	008252STMP	002501SMH	007290IN	207.929	1.5	11.48	7.71	0.2	0.3	0.555	1.385	0.955	0.615	0	0	0	0	Insufficient Freeboard
8	008261STMP	002503SMH	007292IN	31.641	1.25	6.07	4.85	1.1	1.1	Flooded	Flooded	Flooded	Flooded	0.73833333	0.85	2184.34	3472.15	Flooded
8	008263STMP	002504SMH	002506SMH	50.653	1.25	10.94	8.7	1.3	1.6	Flooded	Flooded	Flooded	Flooded	0.79333333	1.03833333	2769.79	4288.32	Flooded
8	007377STMP	002505SMH	002920SMH	173.246	1.25	9.03	7.21	1.8	2	Flooded	Flooded	Flooded	Flooded	0.59833333	1.53333333	494.7	12155.18	Flooded
8	007376STMP	002506SMH	002505SMH	37.355	1.25	9.35	7.46	1.6	1.8	Flooded	Flooded	Flooded	Flooded	1.03833333	0.59833333	4288.32	494.7	Flooded
8	008268STMP	002920SMH	002921SMH	15.057	1.25	11.99	9.54	2	11.1	Flooded	Flooded	Flooded	Flooded	1.53333333	0.70666667	12155.18	314.93	Flooded
8	008003STMP	002921SMH	007294IN	65.302	1.25	10.98	8.76	11.1	27.1	Flooded	3.445	Flooded	1.503	0.70666667	0	314.93	0	Flooded
8	008255STMP	002924SMH	002496SMH	267.658	1.25	11.89	11.91	0	0.5	-	3.018	-	0.052	0	0	0	0	Sufficient Capacity
8	007685STMP	002925SMH	002926SMH	105.055	1.25	9.55	9.21	0	0	-	-	-	-	0	0	0	0	Sufficient Capacity
8	007125STMP	002926SMH	005300IN	228.961	1.25	9.55	12.07	0	1.1	-	Flooded	-	Flooded	0	0.195	0	63.6	Sufficient Capacity
8	007368STMP	002927SMH	002942SMH	150.464	1.5	9.81	11.05	0	0.3	-	1.443	-	-	0	0	0	0	Sufficient Capacity
8	007357STMP	002933SMH	0001090ND	39.407	1.25	4.26	3.41	3.4	16.7	Flooded	Flooded	Flooded	Flooded	1.33666667	1.48666667	2628.35	16.21	Flooded
8	007110STMP	002935SMH	002937SMH	39.497	2	18.34	5.79	43	46	Flooded	2.792	Flooded	0.05	4.685	0	7933.29	0	Flooded
8	007111STMP	002936SMH	002935SMH	38.73	1.25	10.91	8.77	51.9	43	Flooded	Flooded	Flooded	Flooded	5.405	4.685	9680.98	7933.29	Flooded
8	007112STMP	002937SMH	000487IO	114.527	2	18.34	5.79	46	56.3	2.792	Flooded	0.05	Flooded	0	0	0	1.35	Insufficient Freeboard
8	007790A	002938SMH	0001072ND	23.025	1.25	7.64	6.11	43.5	45.1	Flooded	3.494	Flooded	0.575	4.20833333	0	11103.21	0	Flooded
8	008202STMP	002939SMH	002940SMH	25.233	1.25	7.95	6.41	11.5	29.3	Flooded	Flooded	Flooded	Flooded	3.07666667	2.64166667	3773.68	1973.68	Flooded
8	007787STMP	002940SMH	002938SMH	24.398	1.25	7.95	6.4	29.3	43.5	Flooded	Flooded	Flooded	Flooded	2.64166667	4.20833333	1973.68	11103.21	Flooded
8	007109STMP	002941SMH	002935SMH	27.251	2	16.7	5.27	36	43	Flooded	Flooded	Flooded	Flooded	2.97	4.685	9213.37	7933.29	Flooded
8	007791STMP	002942SMH	002954SMH	138.253	1.5	9.83	7.42	0.3	0.9	1.443	Flooded	-	Flooded	0	0.10333333	0	148.66	Surcharged
8	008204STMP	002943SMH	002939SMH	72.01	1.25	-10.24	8.16	17.1	11.5	Flooded	Flooded	Flooded	Flooded	3.6	3.07666667	37169.91	3773.68	Flooded
8	007795STMP	002945SMH	002946SMH	275.467	1.25	10.01	7.93	1.7	18.7	Flooded	Flooded	Flooded	Flooded	1.25	2.32	9700.52	6780.51	Flooded
8	007799STMP	002946SMH	002965SMH	52.895	1.5	10.97	6.12	18.7	34	Flooded	Flooded	Flooded	Flooded	2.32	1.45333333	6780.51	1249.3	Flooded
8	007800STMP	002947SMH	002946SMH	40.53	1	7.15	8.95	16.7	18.7	Flooded	Flooded	Flooded	Flooded	2.99666667	2.32	7742.88	6780.51	Flooded
8	007802STMP	002948SMH	002947SMH	61.269	1	5.4	6.78	5.6	16.7	Flooded	Flooded	Flooded	Flooded	2.98833333	2.99666667	5734.76	7742.88	Flooded
8	007793STMP	002949SMH	002943SMH	217.374	1.5	14.39	8.03	2.2	17.1	Flooded	Flooded	Flooded	Flooded	0.895	3.6	6423.21	37169.91	Flooded
8	007807STMP	002950SMH	002951SMH	60.866	2	27.23	8.54	0.7	0.7	4.744	Flooded	0.896	Flooded	0	0.18166667	0	608.76	Insufficient Freeboard

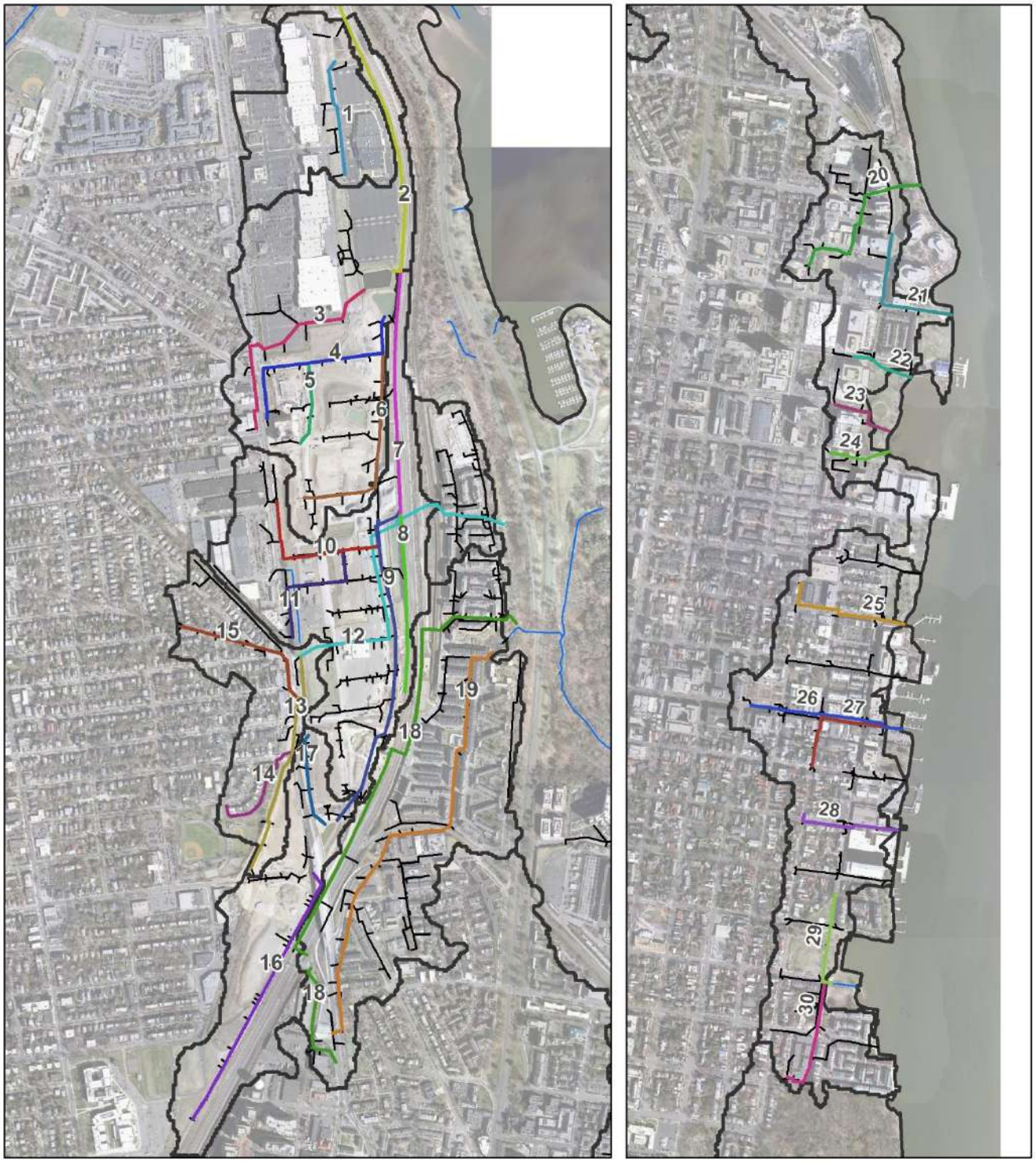
TABLE 1

Potomac River Detailed Hydraulic Model Results

Subshed	DGravityMain FacilityID	Junction FaciltiyID		Length (ft)	Diameter/ Height x Width (ft)	Maximum Flow (ft3/s)	Maximum Velocity (fps)	Duration of Surcharge (hrs)		Surcharge/ Depth Above Crown (ft)		Insufficient Freeboard/ Depth Below Rim (ft)		Duration of Flooding (hrs)		Flooded Volume (ft3)		Summary Pipe Condition
		US	DS					US	DS	US	DS	US	DS	US	DS	US	DS	
8	007379STMP	002951SMH	002957SMH	294.998	2	28.6	8.99	0.7	1.6	Flooded	Flooded	Flooded	Flooded	0.18166667	0.77333333	608.76	4633.52	Flooded
8	007806STMP	002953SMH	002958SMH	79.137	1.5	16.71	9.24	1	1.8	Flooded	Flooded	Flooded	Flooded	0.37	0.635	2425.04	3881.23	Flooded
8	007976STMP	002954SMH	002953SMH	28.391	1.5	21.89	12.13	0.9	1	Flooded	Flooded	Flooded	Flooded	0.10333333	0.37	148.66	2425.04	Flooded
8	007796STMP	002955SMH	002945SMH	76.944	1.25	14.03	11.07	1.4	1.7	Flooded	Flooded	Flooded	Flooded	0.79833333	1.25	7411.11	9700.52	Flooded
8	007108STMP	002956SMH	002941SMH	135.015	2	17.66	5.58	19.7	36	Flooded	Flooded	Flooded	Flooded	1.90666667	2.97	12490.42	9213.37	Flooded
8	007107STMP	002957SMH	002956SMH	45.022	2	28.27	8.96	1.6	19.7	Flooded	Flooded	Flooded	Flooded	0.77333333	1.90666667	4633.52	12490.42	Flooded
8	007804STMP	002958SMH	002949SMH	30.77	1.5	19.05	10.58	1.8	2.2	Flooded	Flooded	Flooded	Flooded	0.635	0.895	3881.23	6423.21	Flooded
8	007113STMP	002959SMH	0001080ND	23.465	1.25	9.14	10.68	0	0	-	-	-	-	0	0	0	0	Sufficient Capacity
8	007378STMP	002960SMH	002950SMH	267.653	2	27.23	12.67	0	0.7	-	4.744	-	0.896	0	0	0	0	Sufficient Capacity
8	007115STMP	002961SMH	002960SMH	115.638	1.5	14.72	13.24	0	0	-	-	-	-	0	0	0	0	Sufficient Capacity
8	007116STMP	002962SMH	002961SMH	155.228	1.25	14.72	12.01	0.4	0	Flooded	-	Flooded	-	0.085	0	115.17	0	Flooded
8	007122STMP	002965SMH	002975SMH	138.451	1.5	-10.38	5.79	34	29.1	Flooded	2.172	Flooded	-	1.45333333	0	1249.3	0	Flooded
8	008214STMP	002966SMH	007280IN	104.184	1	5.65	7.09	0.7	0.7	Flooded	2.56	Flooded	0.35	0.62333333	0	1486.91	0	Flooded
8	014320STMP	002970SMH	002971SMH	16.33	1	-6.91	-8.67	72	72	Flooded	4.966	Flooded	0.534	0.57166667	0	254.08	0	Flooded
8	007365STMP	002971SMH	0001089ND	171.631	1.5	-11.29	-6.26	72	72	4.466	6.909	0.534	0.02	0	0	0	0	Insufficient Freeboard
8	007436STMP	002973SMH	005304IN	19.57	1	5.19	-6.56	72	72	Flooded	Flooded	Flooded	Flooded	2.86833333	2.34666667	5349.23	6972.8	Flooded
8	007437STMP	002975SMH	000489IO	124.633	1.5	-10.39	5.83	29.1	24.3	2.172	0.814	-	-	0	0	0	0	Surcharged
8	007438STMP	002976SMH	004122SMH	48.593	3	71.62	10.26	0	0	-	-	-	-	0	0	0	0	Sufficient Capacity
8	007440STMP	002977SMH	002976SMH	21.926	3	56.55	9.34	0	0	-	-	-	-	0	0	0	0	Sufficient Capacity
8	007445STMP	002978SMH	005322IN	182.002	1.5	9.68	15.33	0	0	-	-	-	-	0	0	0	0	Sufficient Capacity
8	007442STMP	002979SMH	002977SMH	100.429	2.5	25.33	5.97	0	0	-	-	-	-	0	0	0	0	Sufficient Capacity
8	007439STMP	002983SMH	002976SMH	211.206	3	16.59	3.04	0	0	-	-	-	-	0	0	0	0	Sufficient Capacity
8	007429STMP	002984SMH	002983SMH	189.717	3	16.12	3.43	0	0	-	-	-	-	0	0	0	0	Sufficient Capacity
8	015236STMP	002985SMH	004120SMH	129.883	2.5	14.66	4.88	0	0	-	-	-	-	0	0	0	0	Sufficient Capacity
8	008010STMP	002986SMH	003017SMH	16.406	1.5	10.93	8.89	0	0.1	-	0.303	-	-	0	0	0	0	Sufficient Capacity
8	007693STMP	002987SMH	005328IN	33.138	2.5	25.46	5.17	0.5	49.8	0.831	2.166	-	-	0	0	0	0	Surcharged
8	008011STMP	002989SMH	002986SMH	134.405	1.5	-10.93	6.3	0.4	0	1.191	-	-	-	0	0	0	0	Surcharged
8	008019STMP	002990SMH	002991SMH	18.796	1.5	8.89	6.97	0	0.1	-	0.384	-	-	0	0	0	0	Sufficient Capacity
8	008018STMP	002991SMH	002992SMH	79.52	1.5	8.9	5.03	0.1	0.5	0.384	1.278	-	1.432	0	0	0	0	Surcharged
8	007859STMP	002992SMH	003016SMH	155.392	1.75	-8.91	3.86	0.5	0	1.028	-	1.432	-	0	0	0	0	Insufficient Freeboard
8	007433STMP	002994SMH	002995SMH	112.475	1.75	7.8	5.99	0	0	-	-	-	-	0	0	0	0	Sufficient Capacity
8	007425STMP	002995SMH	005353IN	87.423	1.75	7.9	6.1	0	0.3	-	0.454	-	-	0	0	0	0	Sufficient Capacity
8	008045STMP	003006SMH	000491IO	153.359	3	39.28	5.54	23.1	31.9	1.301	Flooded	-	Flooded	0	0	0	1.4	Surcharged
8	007449STMP	003016SMH	005351IN	52.063	2	8.9	5.49	0	0	-	-	-	1.683	0	0	0	0	Sufficient Capacity
8	007860STMP	003017SMH	003018SMH	46.411	1.5	10.93	5.98	0.1	0.1	0.303	0.072	-	-	0	0	0	0	Surcharged
8	007861STMP	003018SMH	000496IO	53.436	1.5	10.93	6.12	0.1	0	0.072	-	-	-	0	0	0	0	Surcharged
8	015237STMP	004120SMH	002977SMH	155.763	3	22.15	5.08	0	0	-	-	-	-	0	0	0	0	Sufficient Capacity
8	015239STMP	004122SMH	000495IO	3.549	3	71.62	10.23	0	0	-	-	-	-	0	0	0	0	Sufficient Capacity
8	014289STMP	004275SMH	000592IO	134.671	1.5	15.86	8.9	0.8	0	2.128	-	-	0.004	0	0	0	0.29	Surcharged

TABLE 2
Potomac River Outfall Boundary Conditions

Node ID	Location	Boundary Condition
0001089ND	Potomac River	Computed Tide Coefficeints
000361IO	Four Mile Run	Type 1, Free Outfall
000404IO	GW Parkway Wetlands	Type 1, Free Outfall
000405IO	GW Parkway Wetlands	Type 1, Free Outfall
000469IO	Potomac River	Computed Tide Coefficeints
000470IO	Potomac River	Computed Tide Coefficeints
000471IO	Potomac River	Computed Tide Coefficeints
000472IO	Potomac River	Computed Tide Coefficeints
000479IO	Potomac River	Computed Tide Coefficeints
000480IO	Potomac River	Computed Tide Coefficeints
000481IO	Potomac River	Computed Tide Coefficeints
000483IO	Potomac River	Computed Tide Coefficeints
000484IO	Potomac River	Computed Tide Coefficeints
000487IO	Potomac River	Computed Tide Coefficeints
000489IO	Potomac River	Computed Tide Coefficeints
000491IO	Potomac River	Computed Tide Coefficeints
000495IO	Potomac River	Computed Tide Coefficeints
000496IO	Potomac River	Type 1, Free Outfall
000589IO	GW Parkway Wetlands	Type 1, Free Outfall
000591IO	GW Parkway Wetlands	Type 1, Free Outfall
000592IO	Potomac River	Computed Tide Coefficeints



Legend

Profiles

N/A	1	2	3	4	5	6	7
8	9	10	11	12	13	14	15
16	17	18	19	20	21	22	23
24	25	26	27	28	29	30	

City of Alexandria Streams

Subwatersheds

Potomac River Profile Locations

Stormwater Capacity Analysis for Potomac River Watershed, City of Alexandria, Virginia

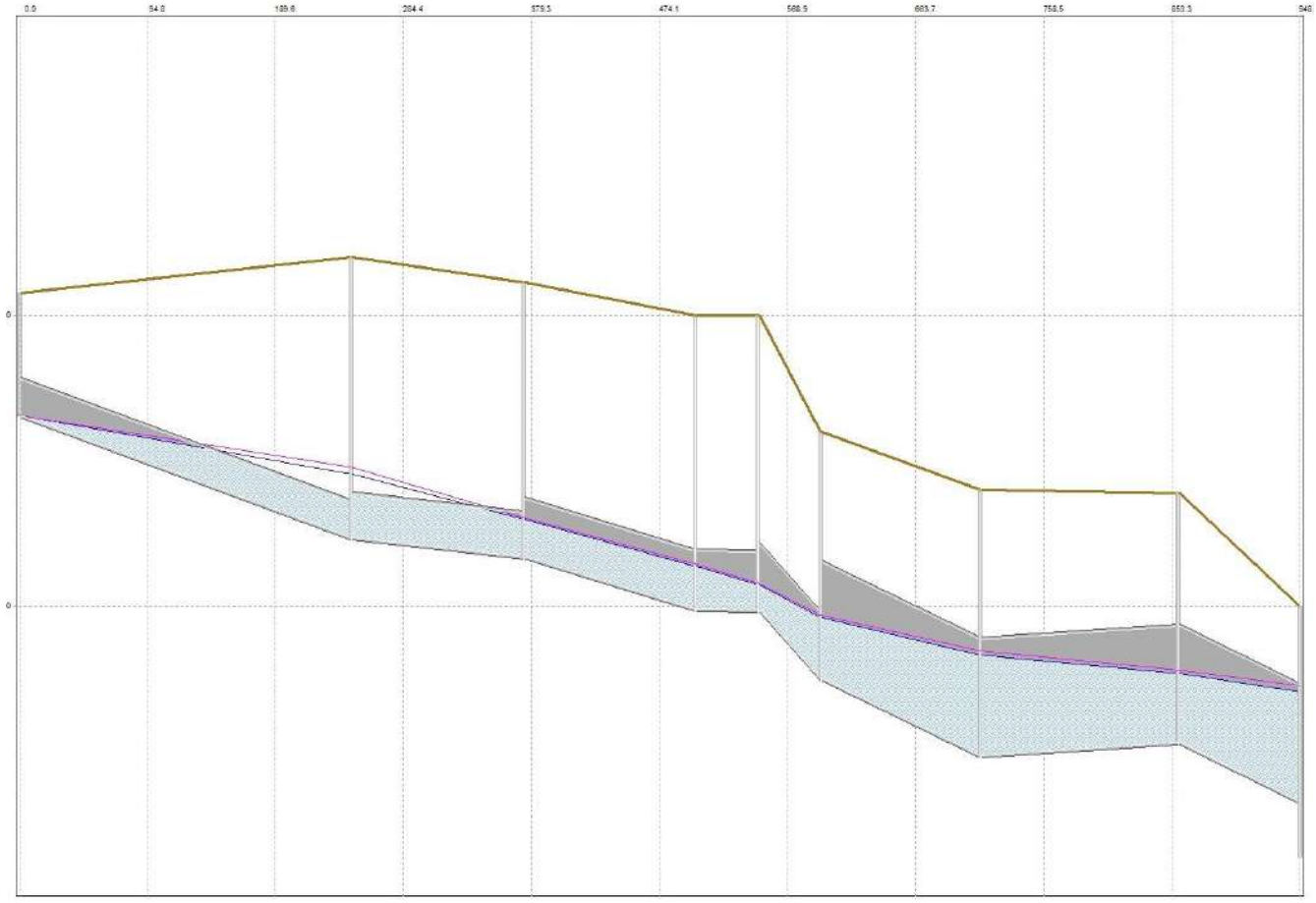
0 500 1,000 2,000

Feet

N

FIGURE 1

Potomac River Profile 1 from 008100IN to 000357IO



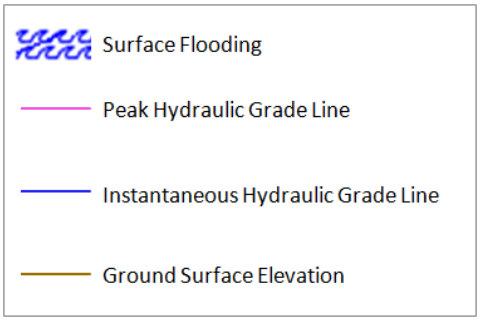
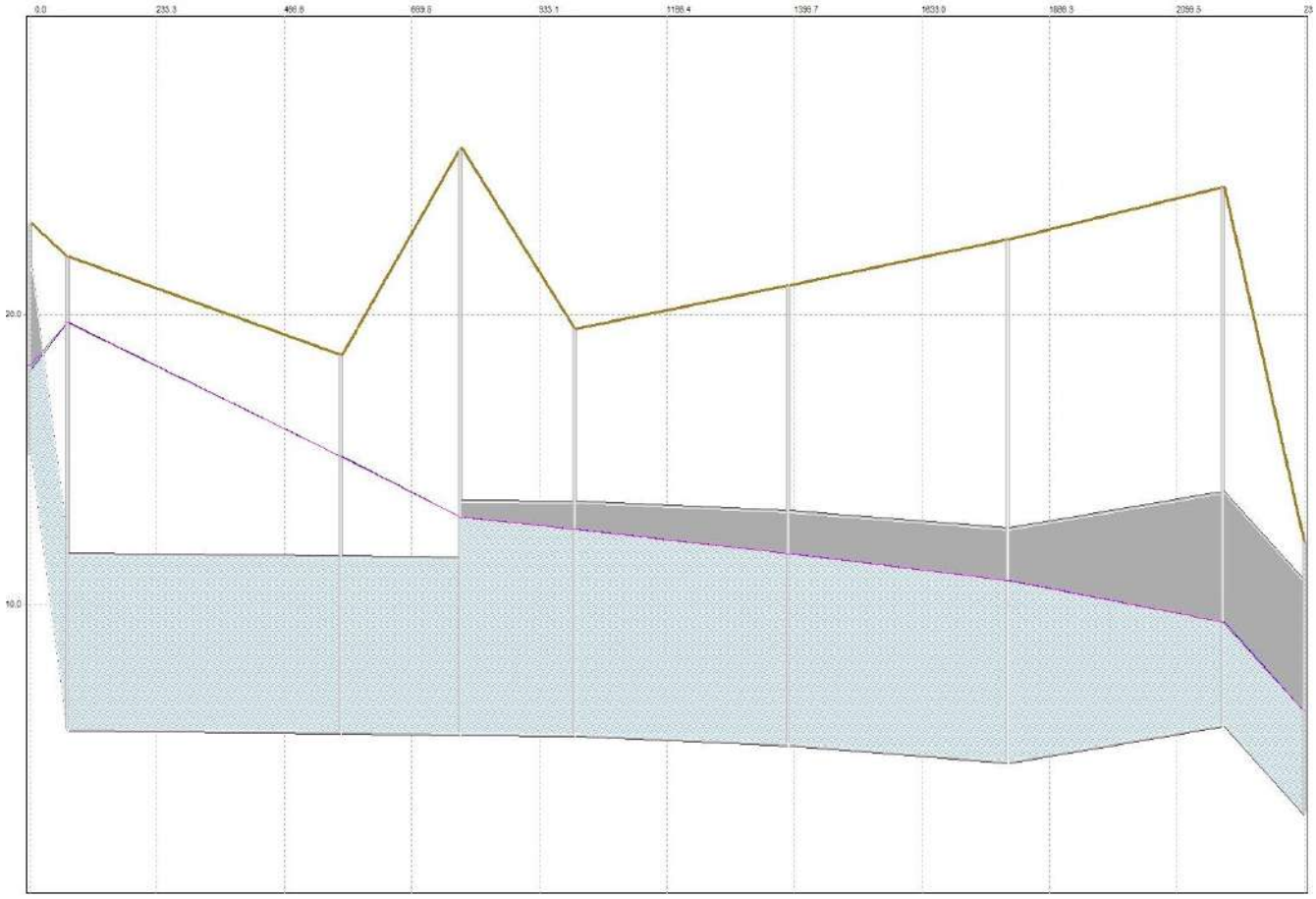


FIGURE 2

Potomac River Profile 2 from 000369IO to 000361IO



Surface Flooding

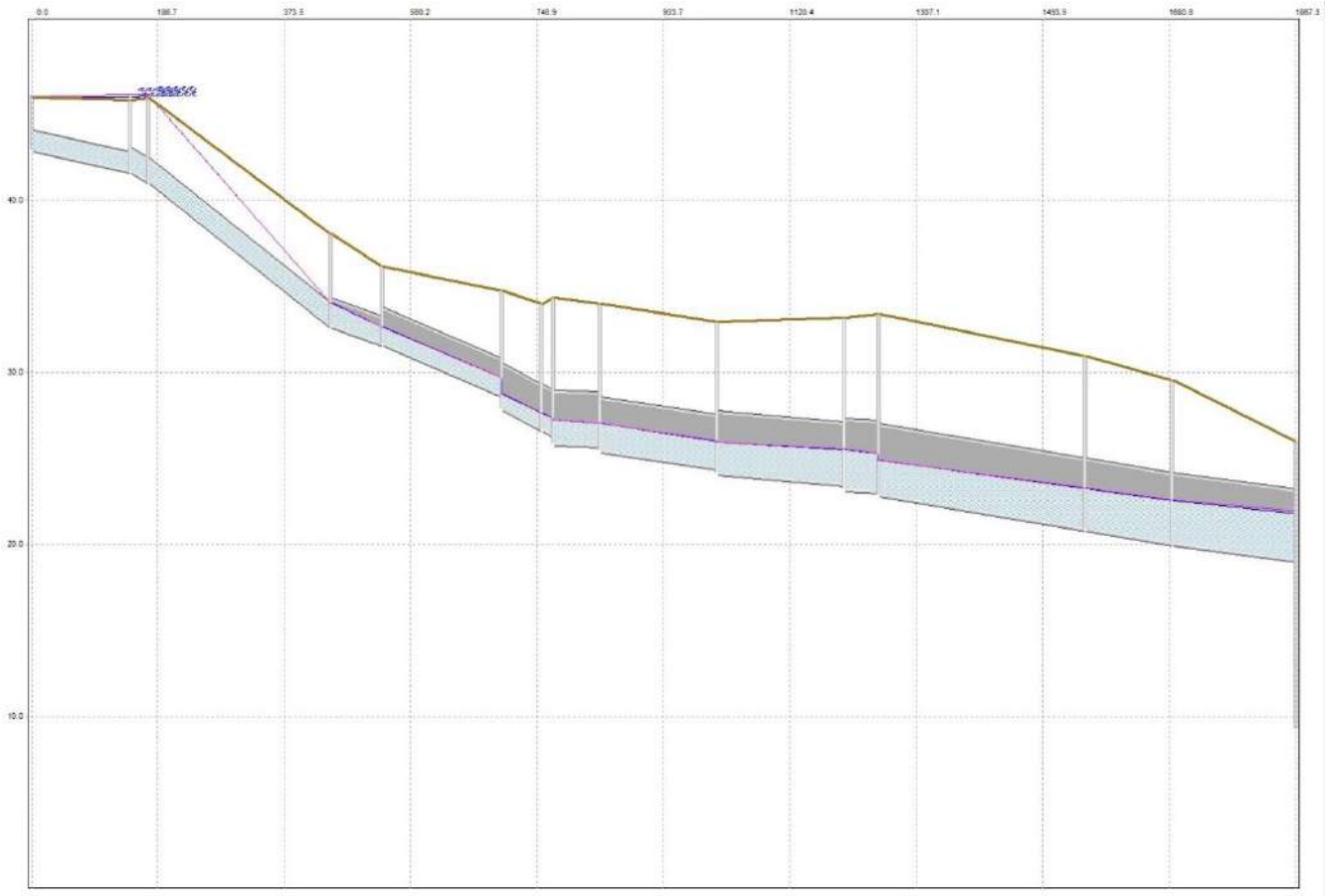
Peak Hydraulic Grade Line

Instantaneous Hydraulic Grade Line

Ground Surface Elevation

FIGURE 3

Potomac River Profile 3 from 001866SMH to 000370IO



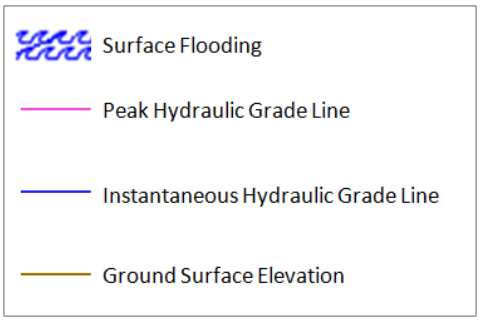
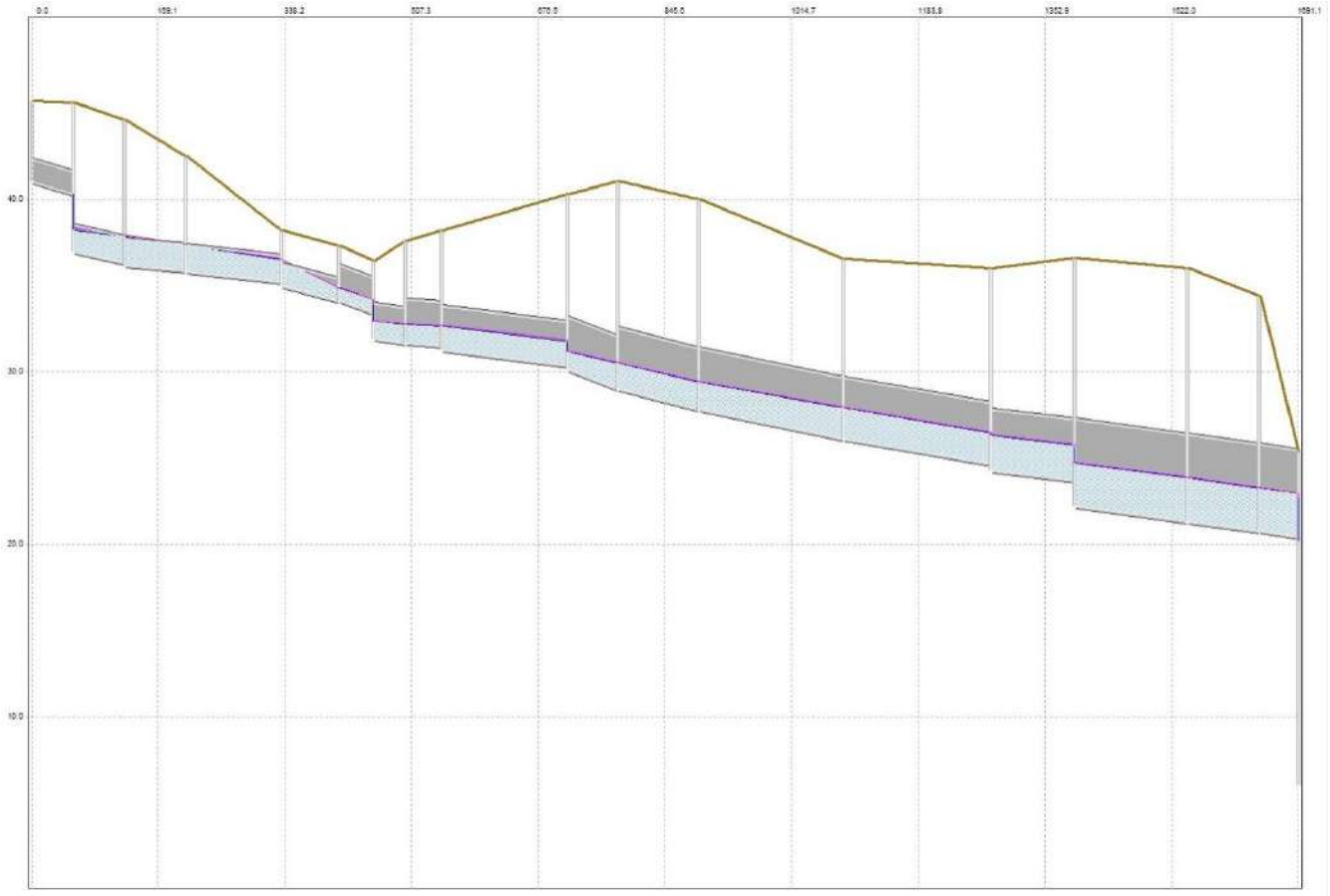


FIGURE 4

Potomac River Profile 4 from 009012IN to 000583IO



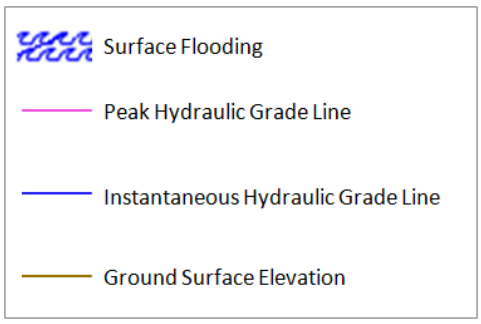
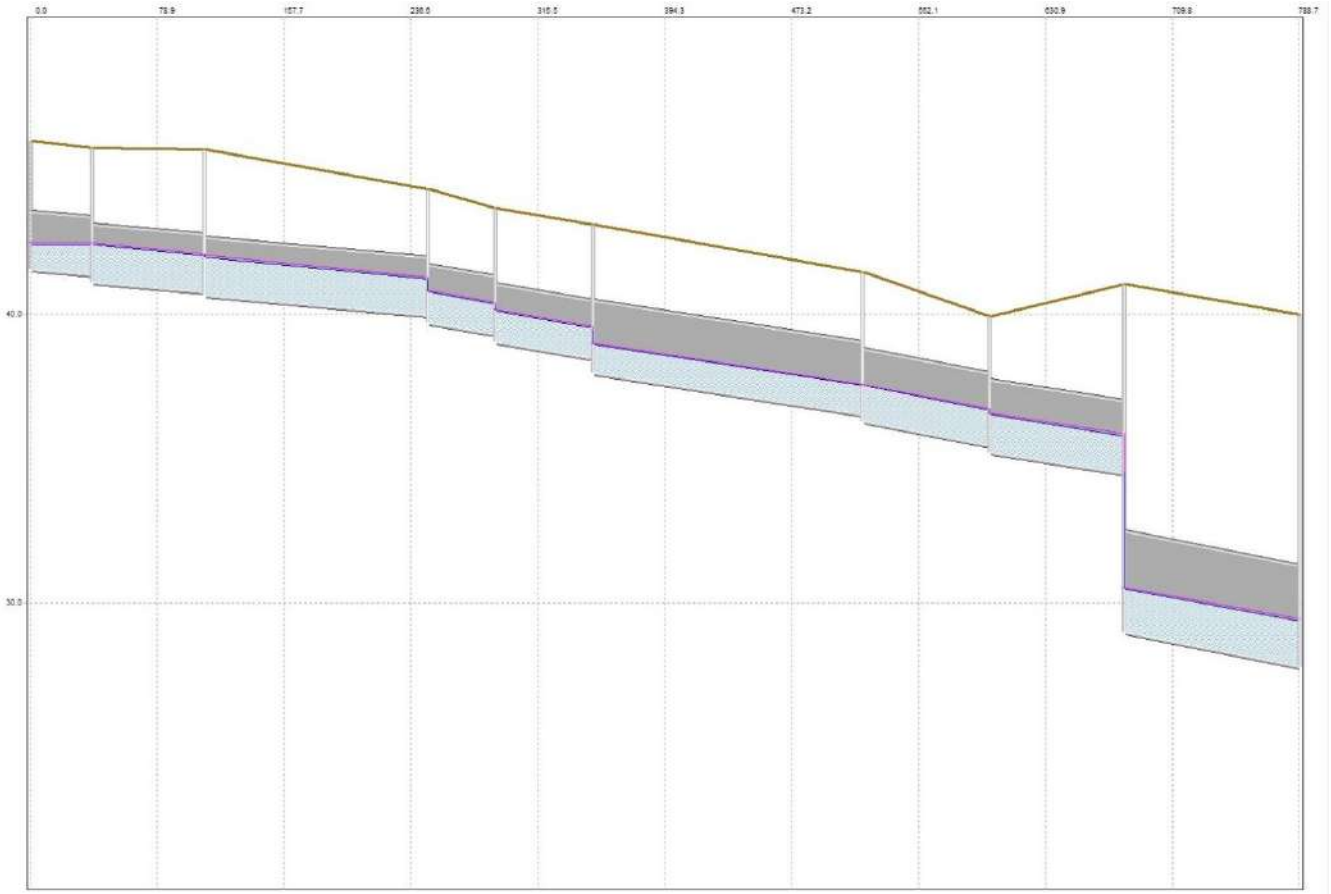


FIGURE 5

Potomac River Profile 5 from 009129IN to 009118IN



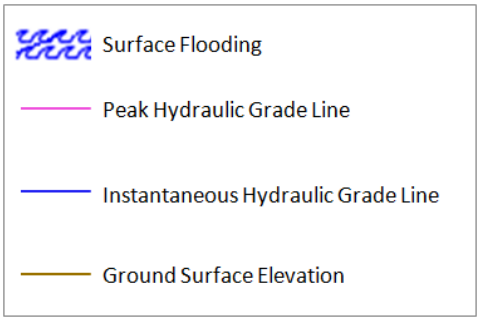
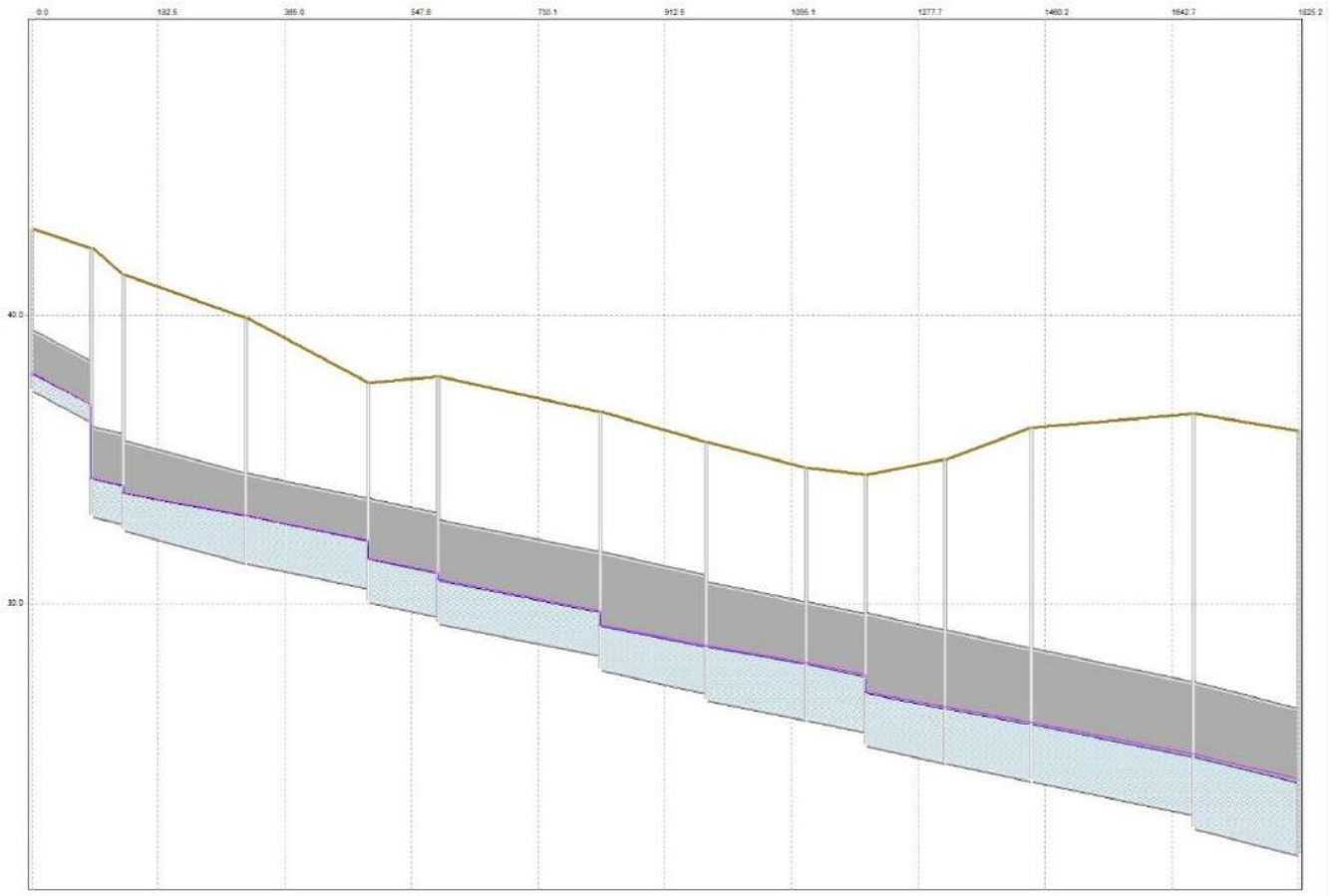


FIGURE 6

Potomac River Profile 6 from 009169IN to 009111IN



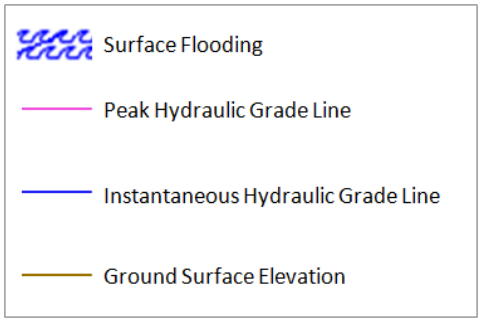
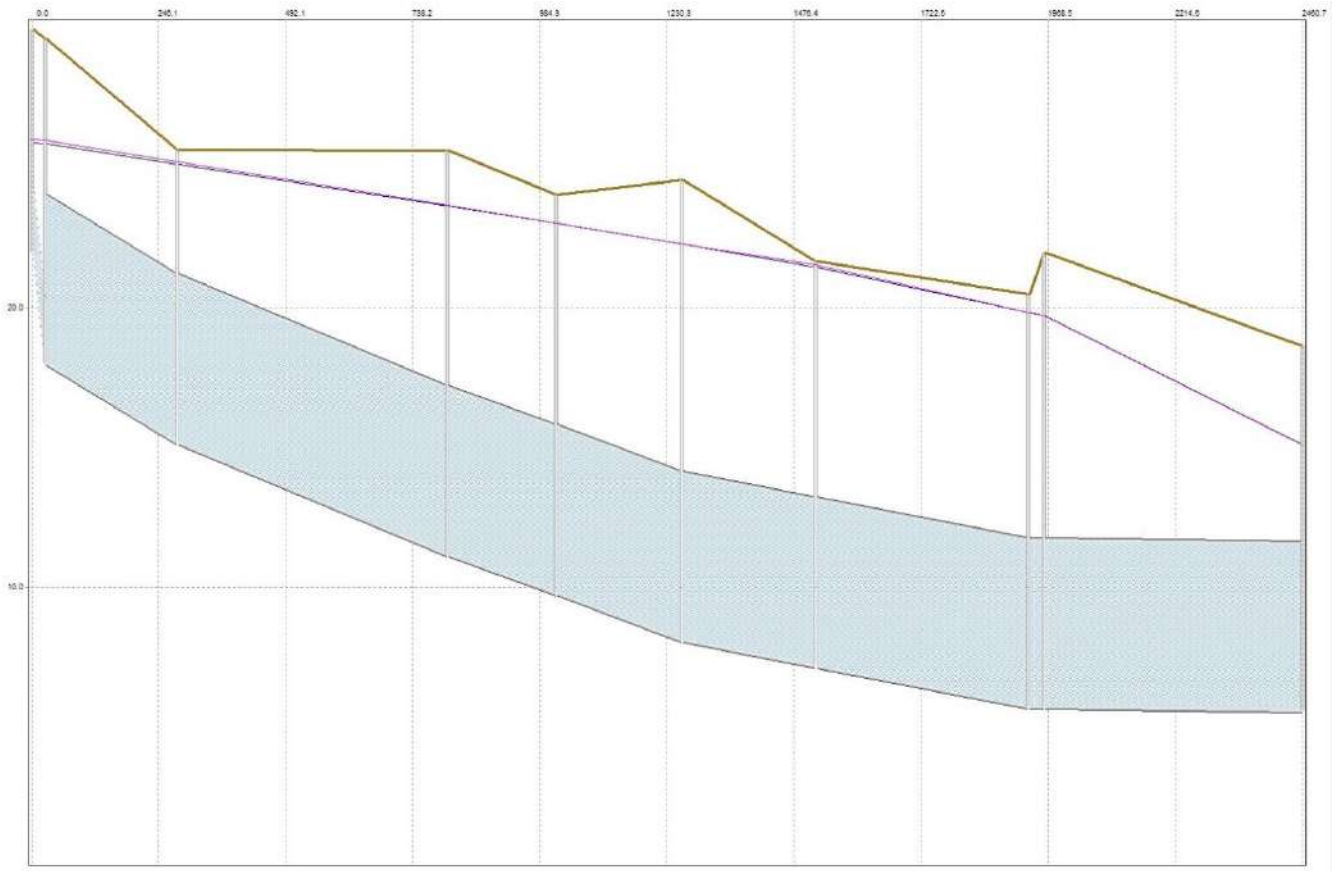


FIGURE 7

Potomac River Profile 7 from 009249IN to 008133IN



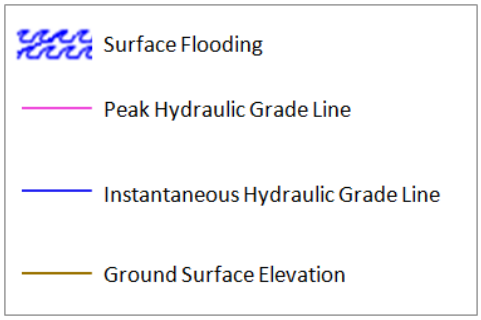
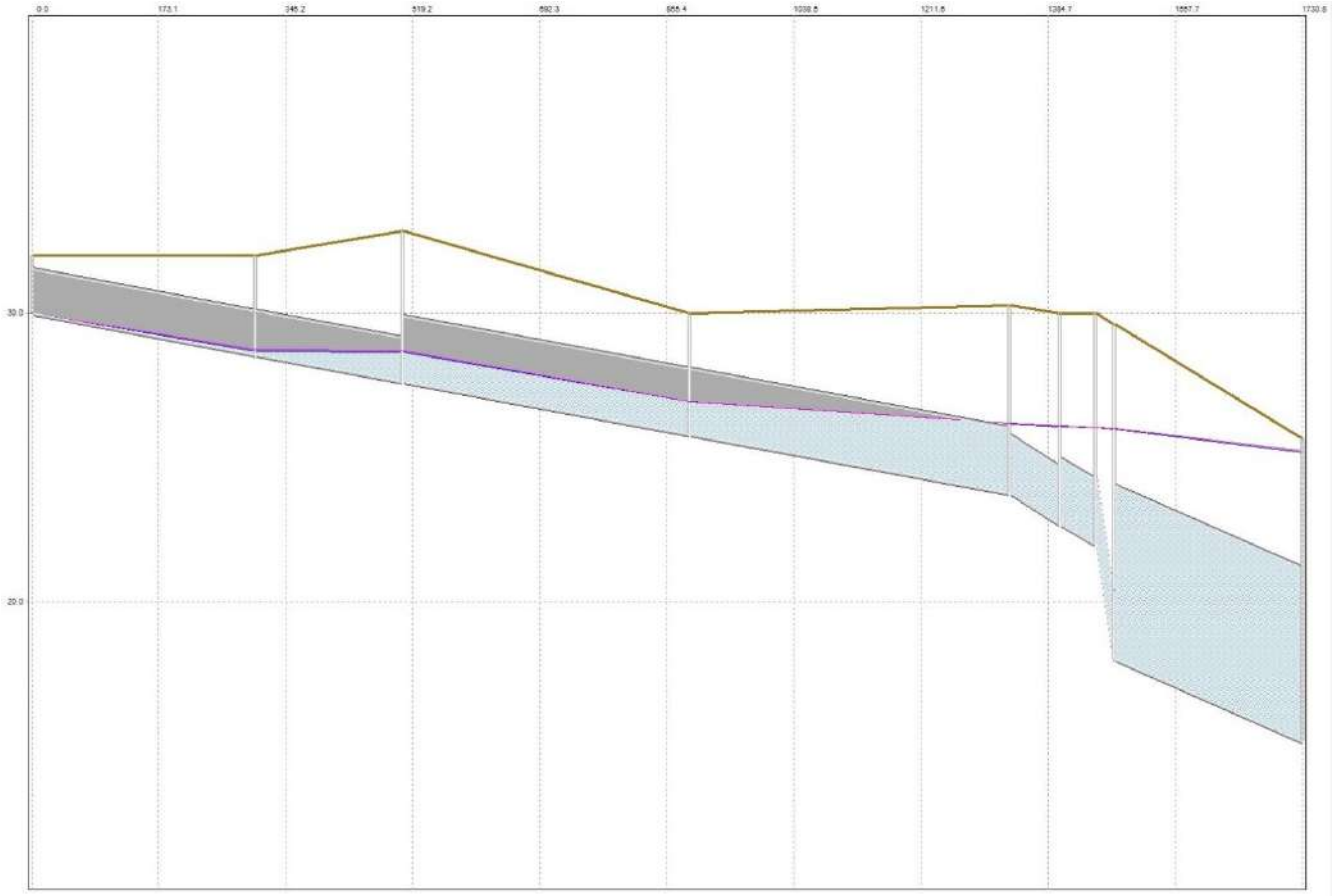


FIGURE 8

Potomac River Profile 8 from 009298IN to 008139IN



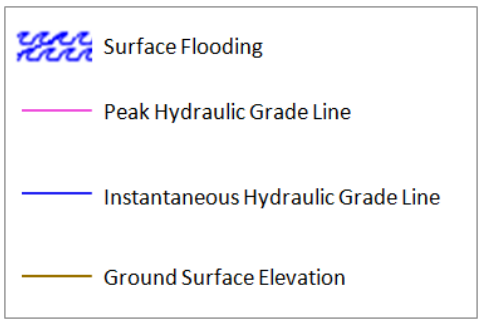
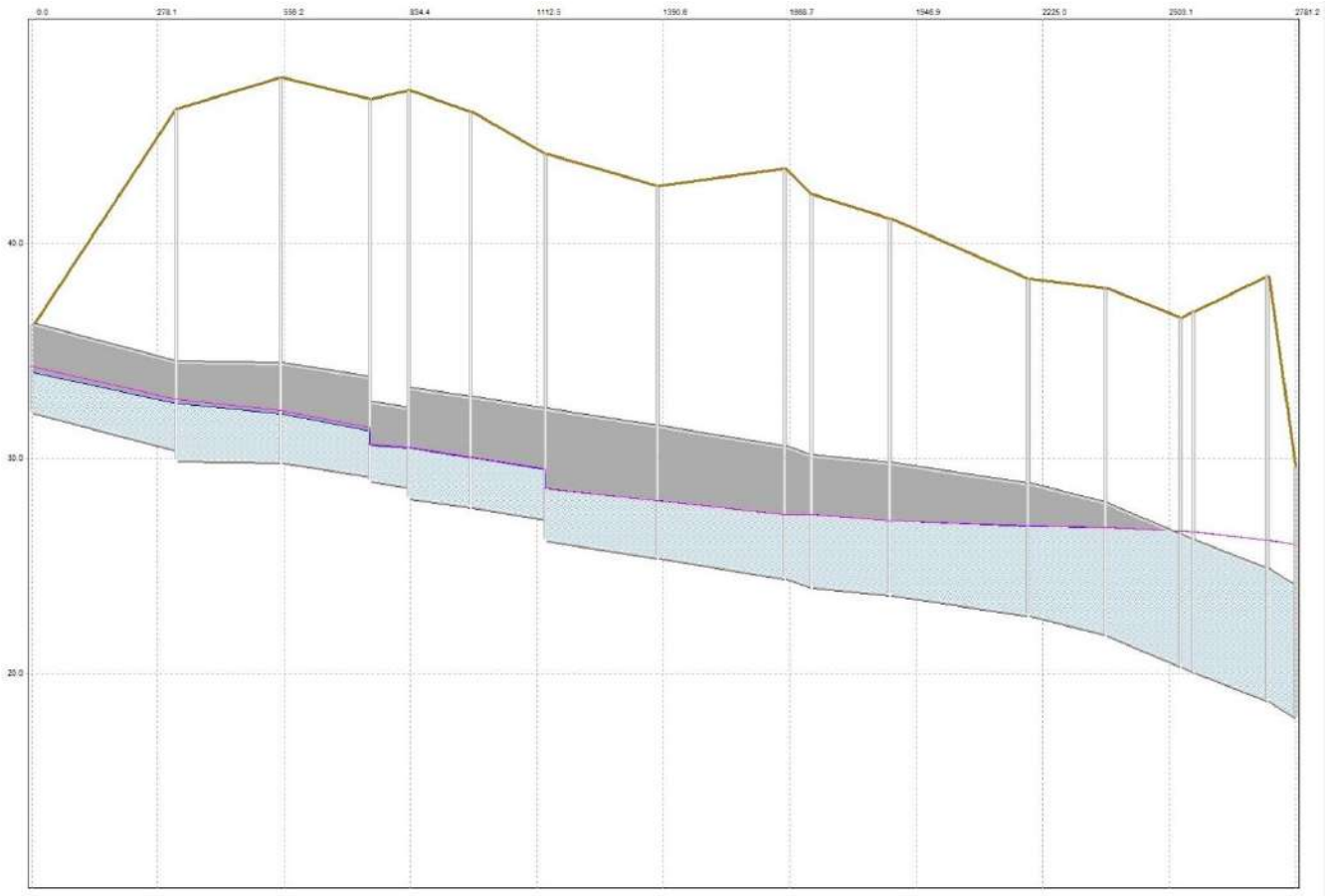


FIGURE 9

Potomac River Profile 9 from 002354ND to 001843SMH



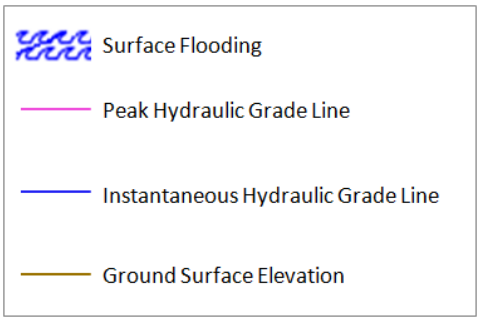
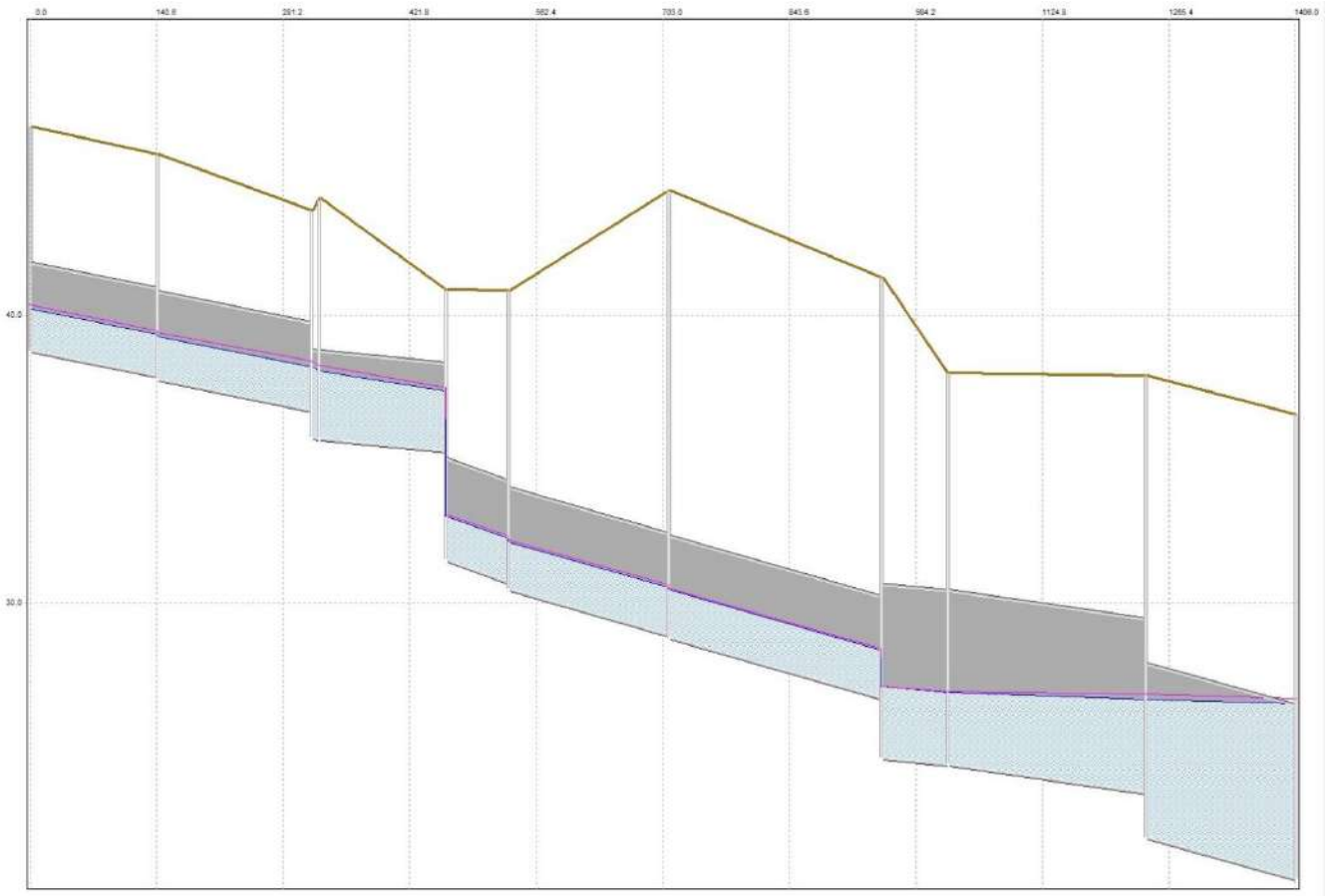


FIGURE 10

Potomac River Profile 10 from 004045SMH to 004835SMH



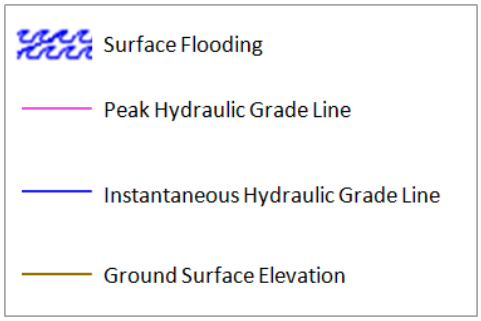
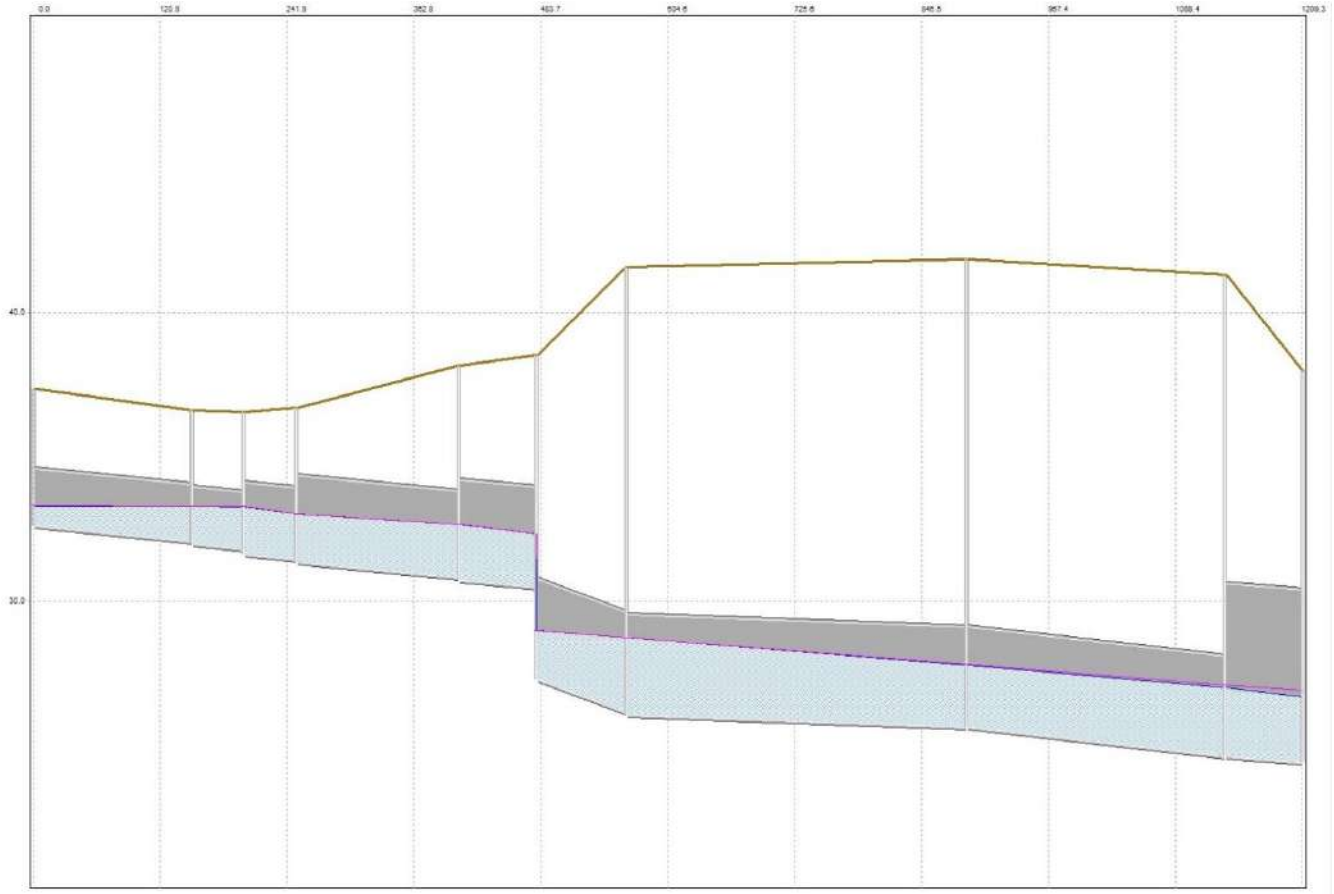


FIGURE 11

Potomac River Profile 11 from 008302IN to 004850SMH



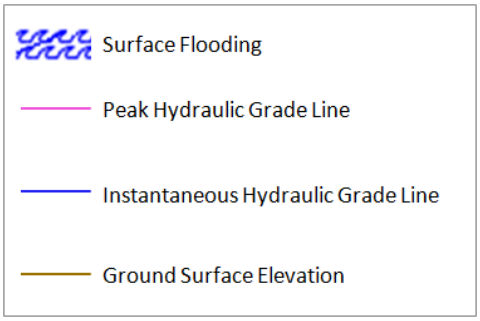
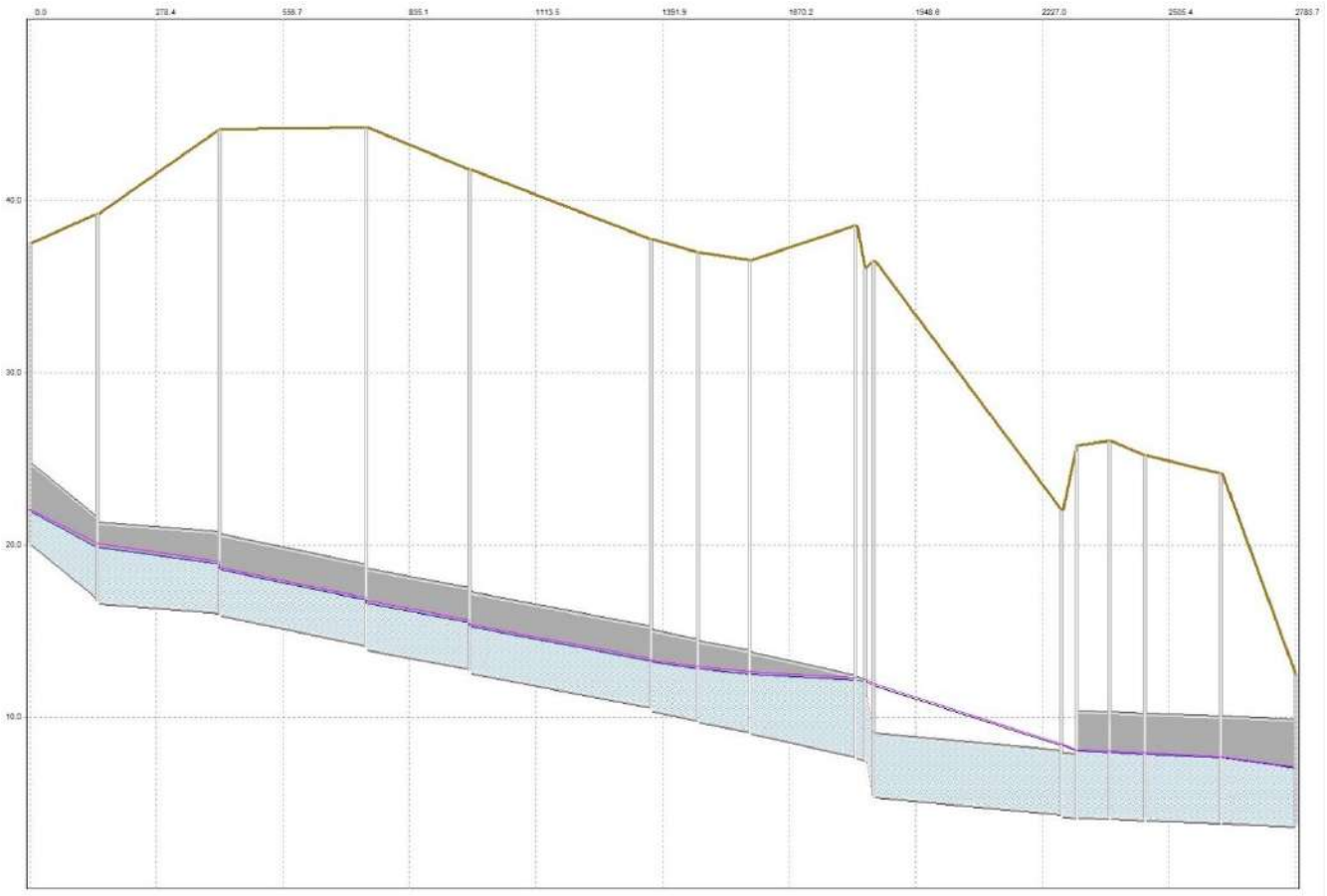


FIGURE 12

Potomac River Profile 12 from 004806SMH to 000589IO



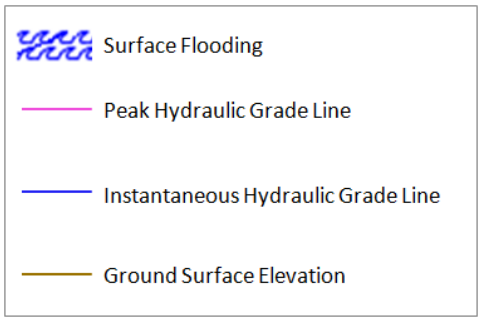
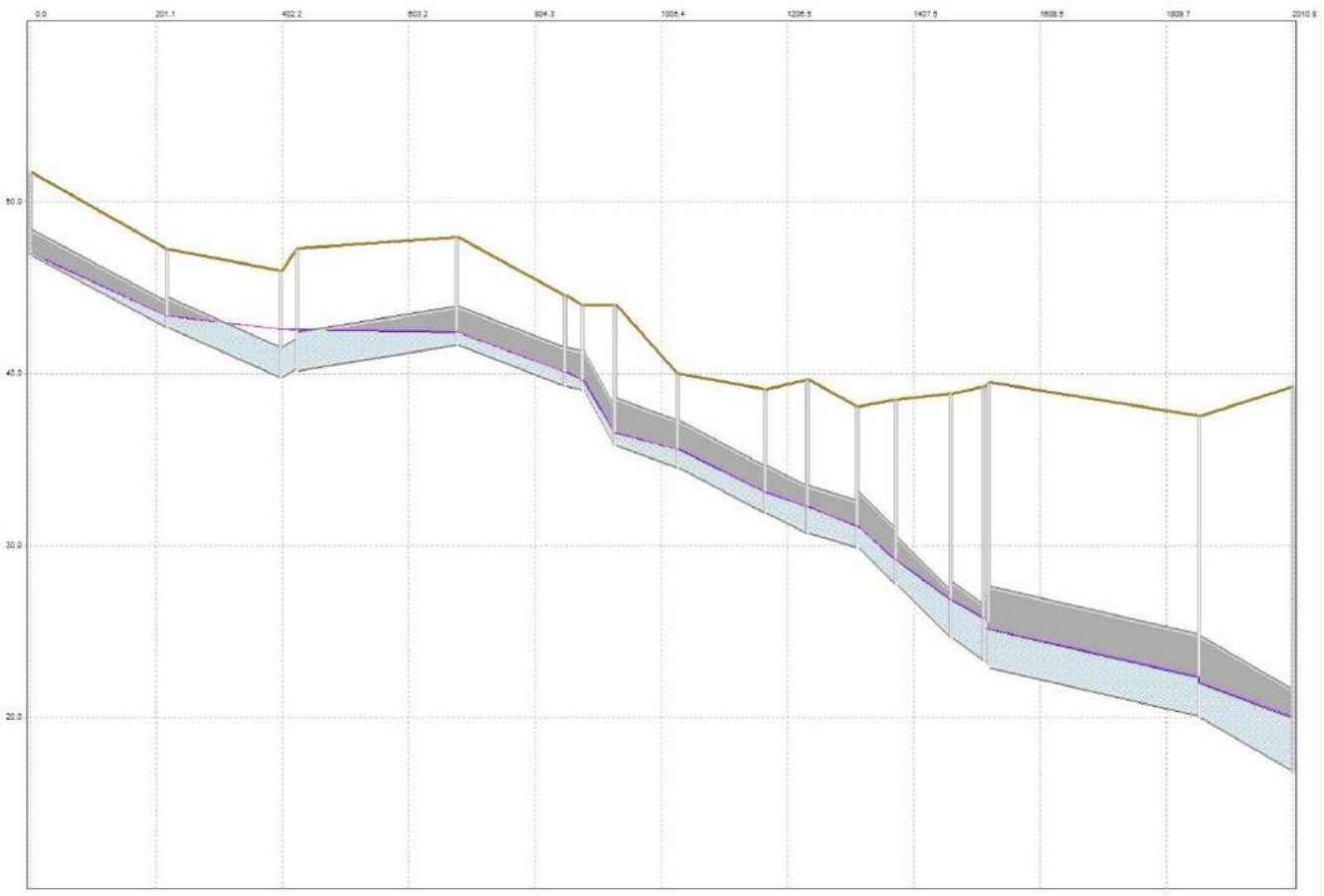
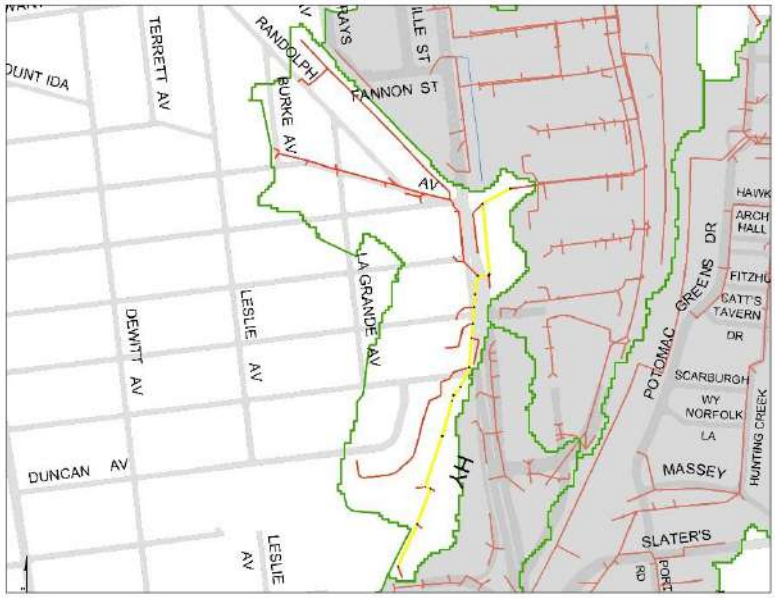


FIGURE 13

Potomac River Profile 13 from 007476IN to 004807SMH





Surface Flooding

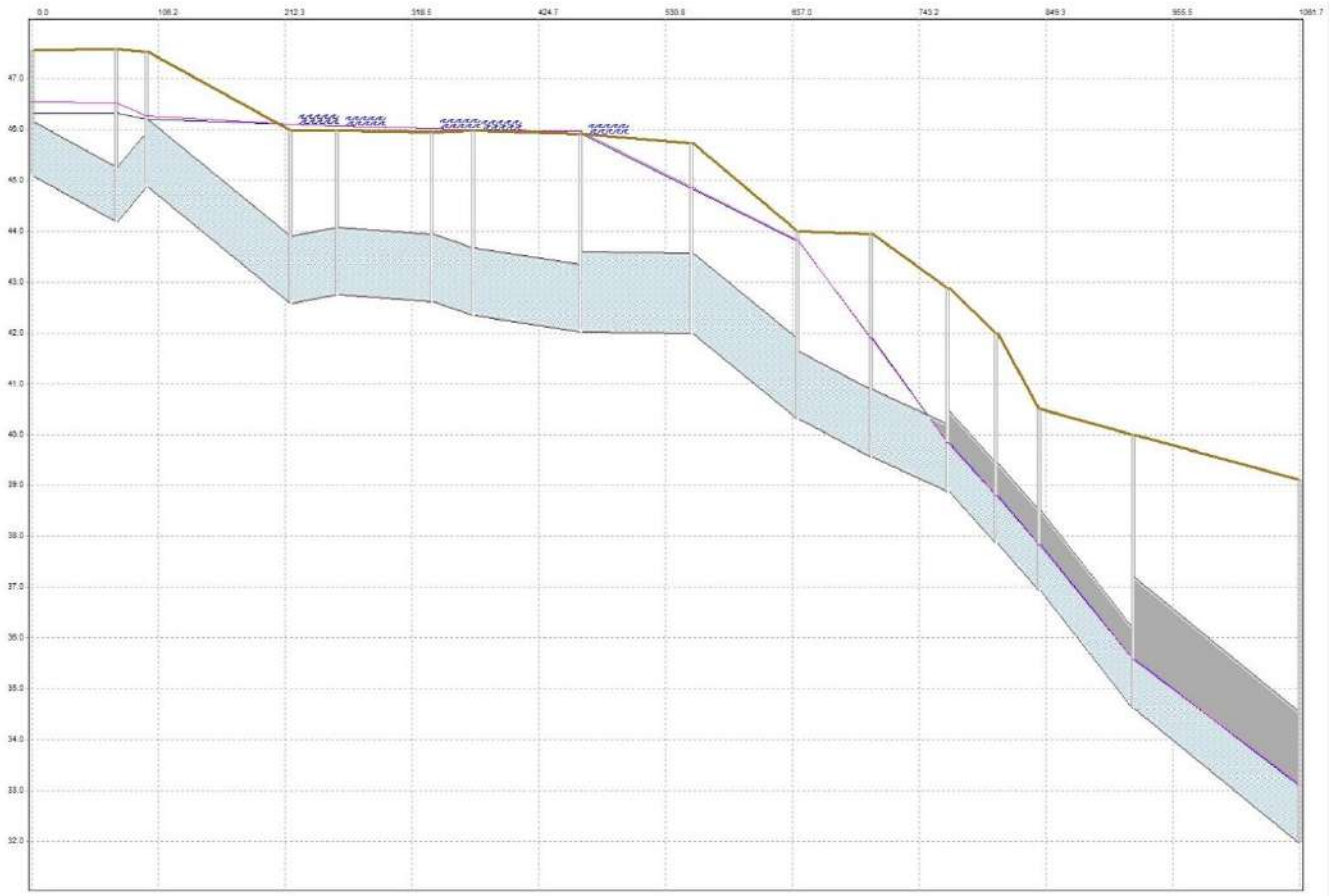
Peak Hydraulic Grade Line

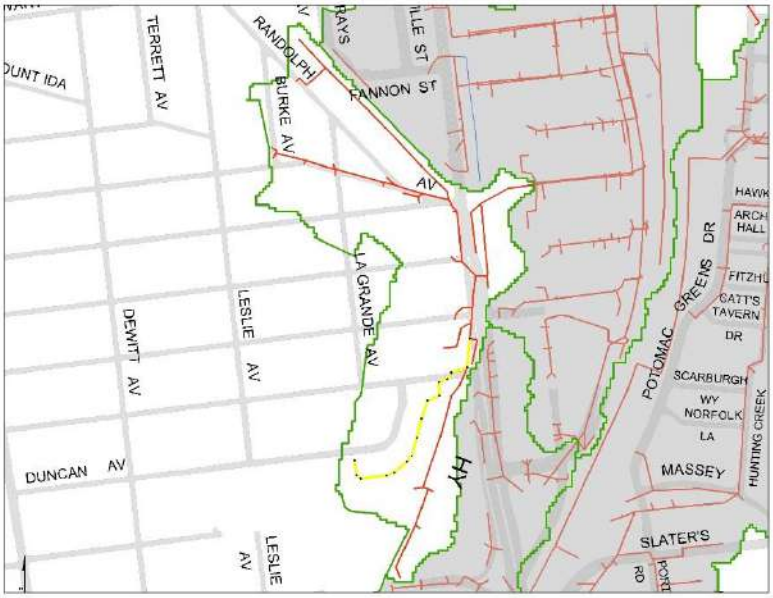
Instantaneous Hydraulic Grade Line

Ground Surface Elevation

FIGURE 14

Potomac River Profile 14 from 007985IN to 009823IN





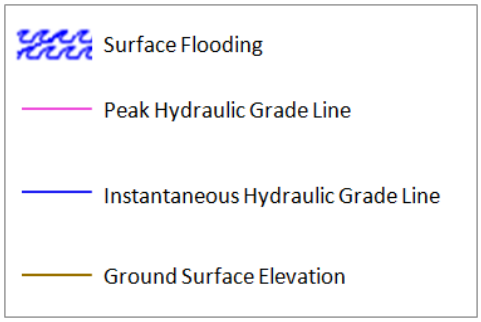
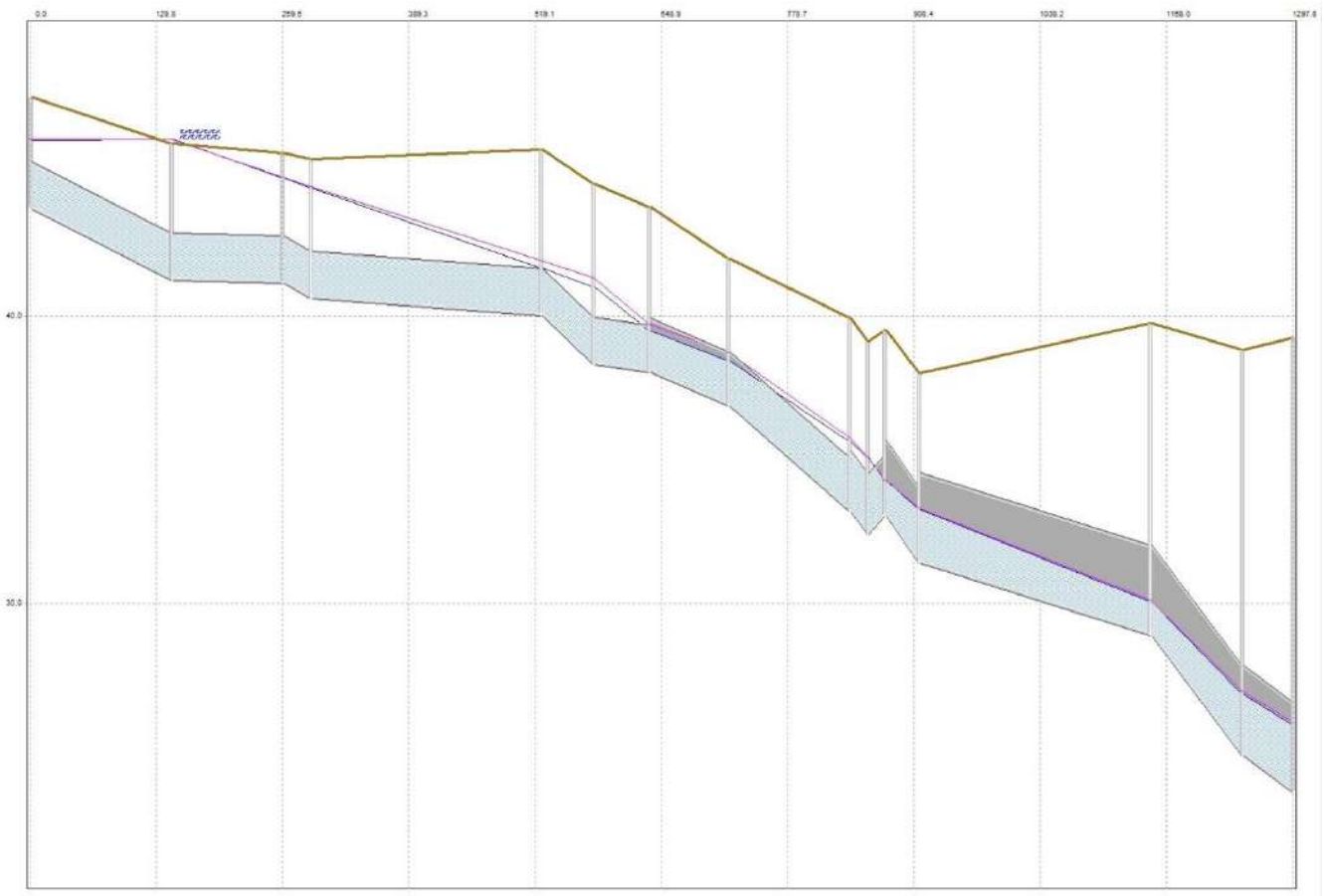
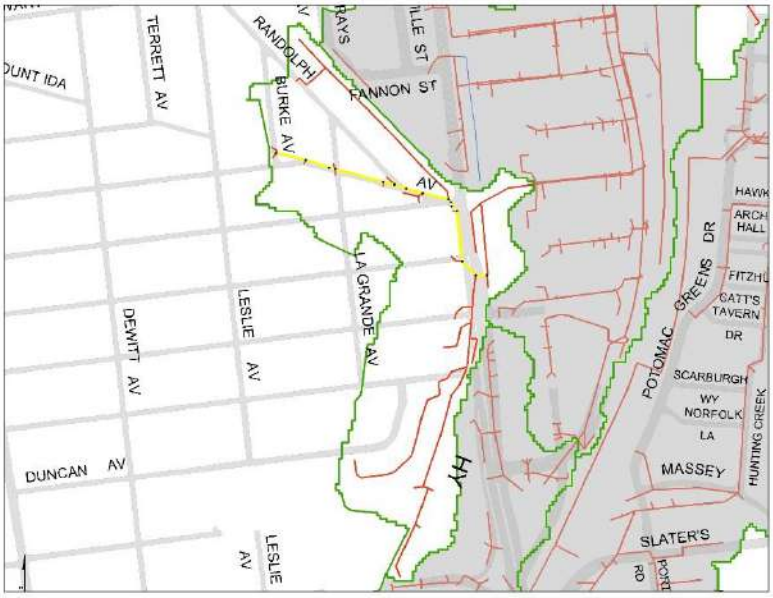


FIGURE 15

Potomac River Profile 15 from 002690SMH to 009071IN





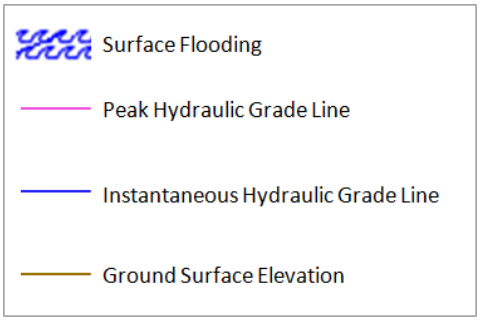
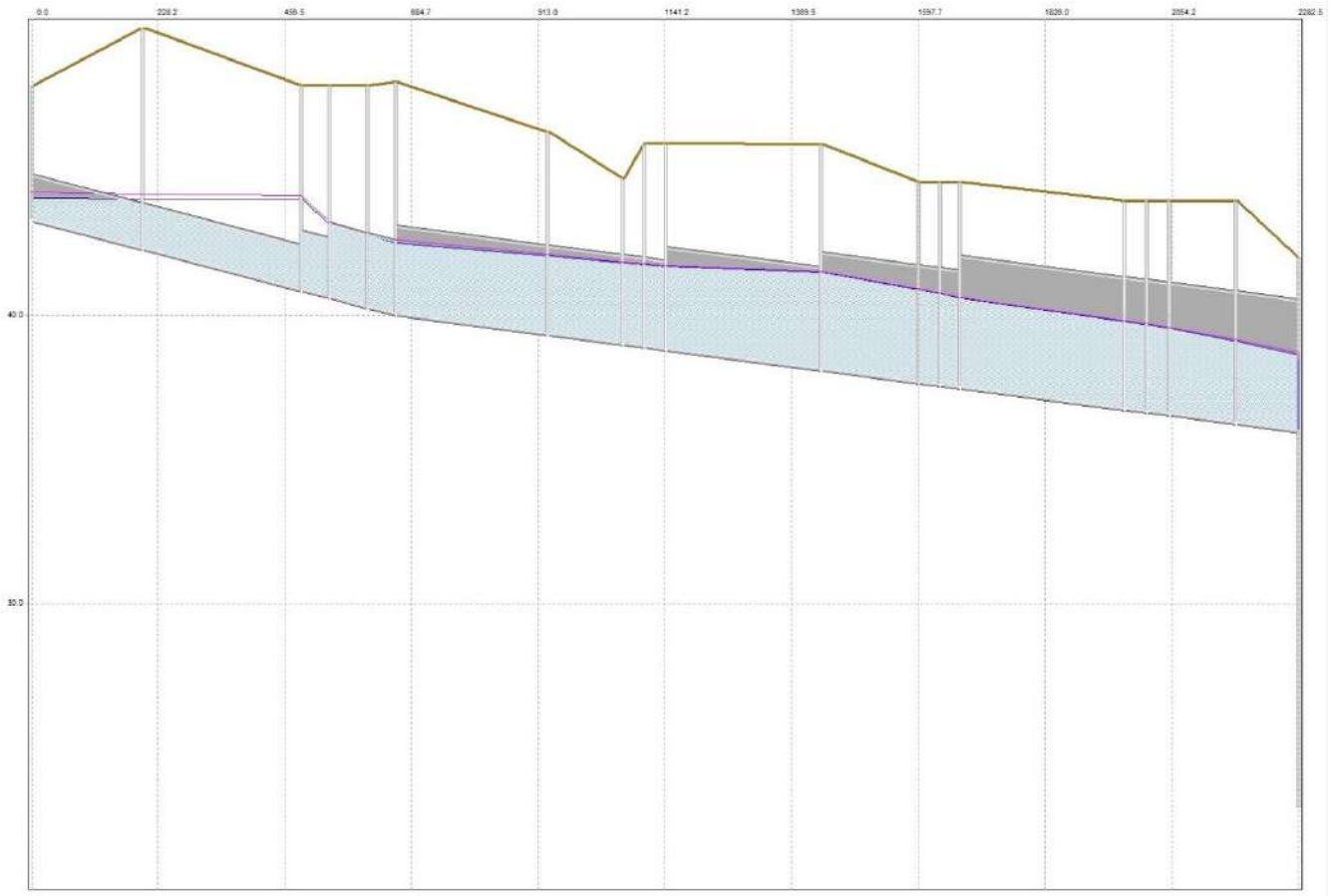
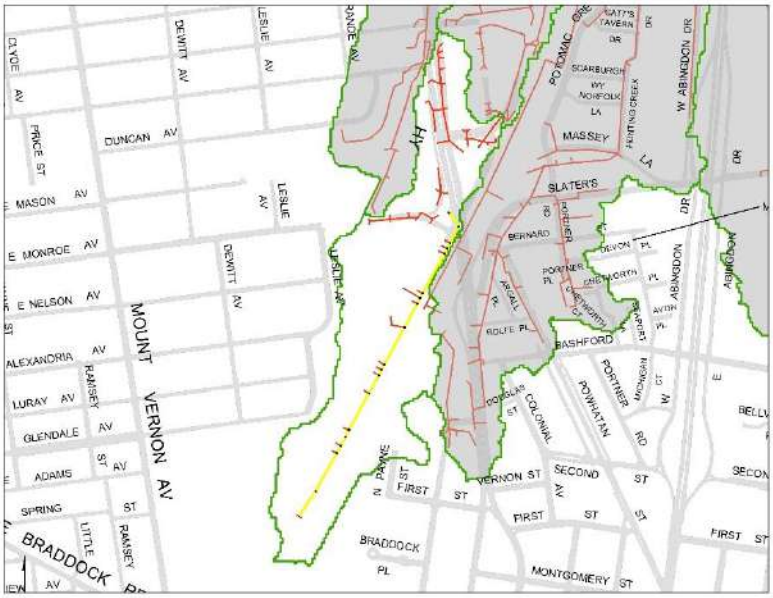


FIGURE 16

Potomac River Profile 16 from 004198SMH to 000588IO





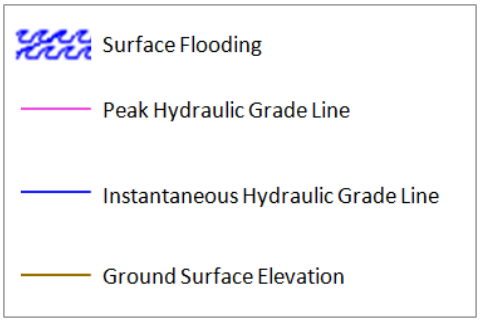
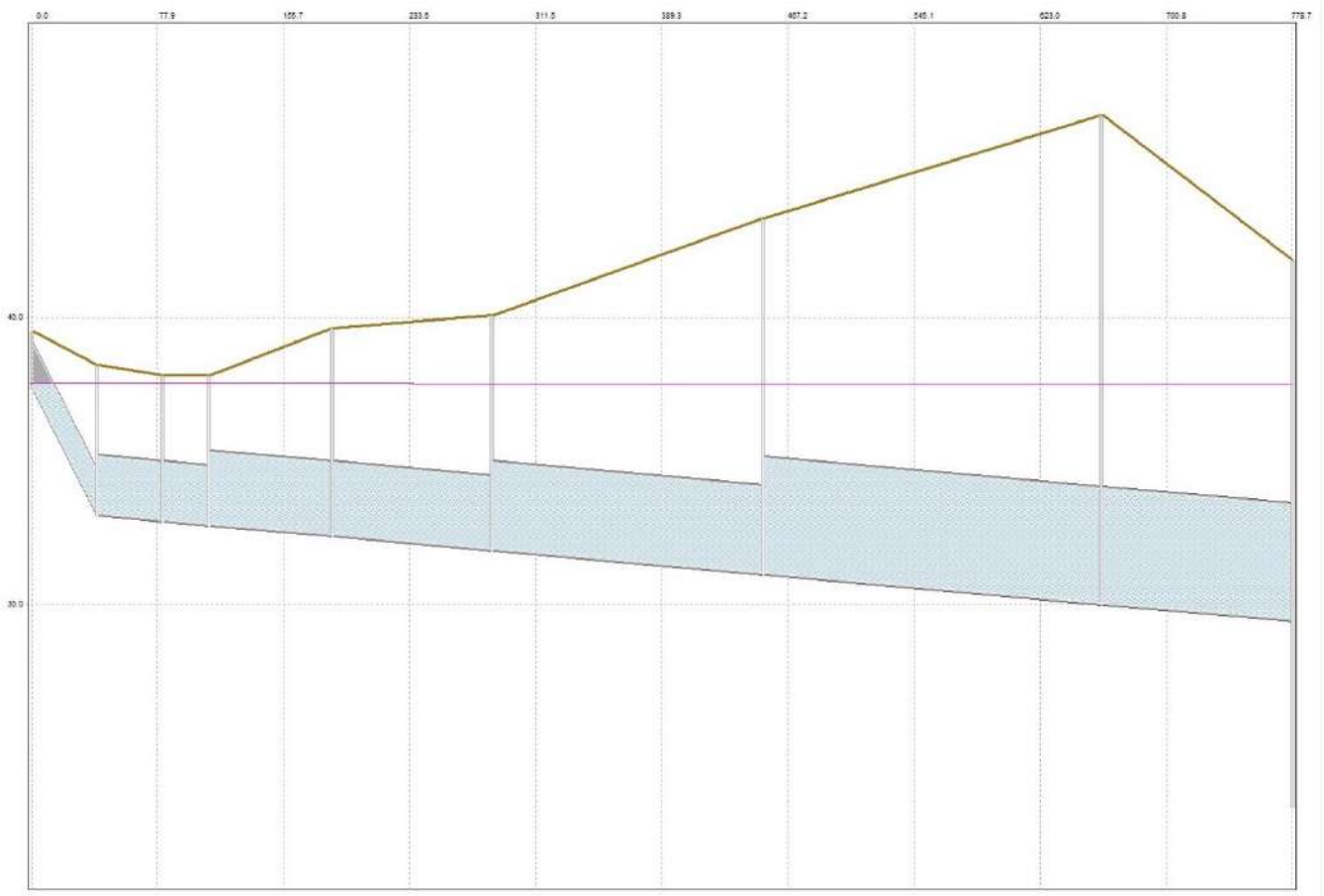
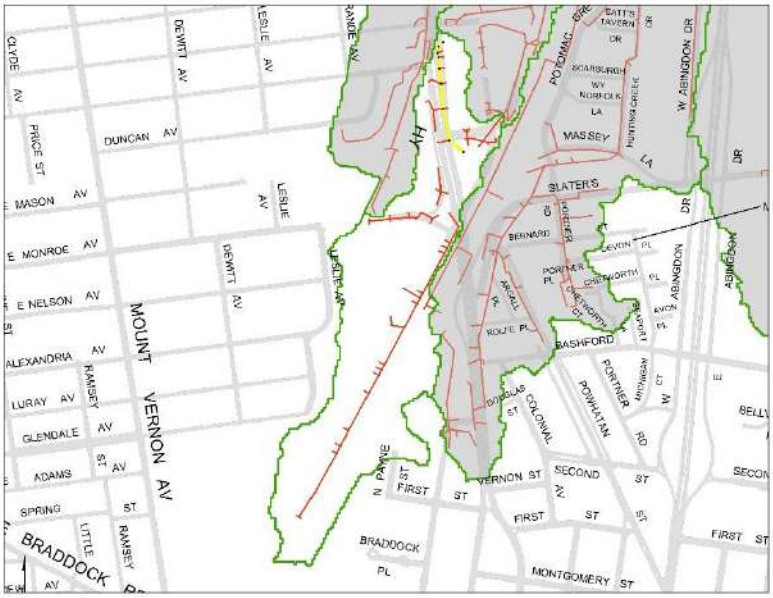


FIGURE 17

Potomac River Profile 17 from 009079IN to 000576IO





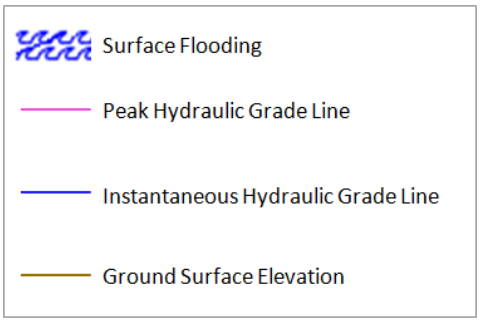
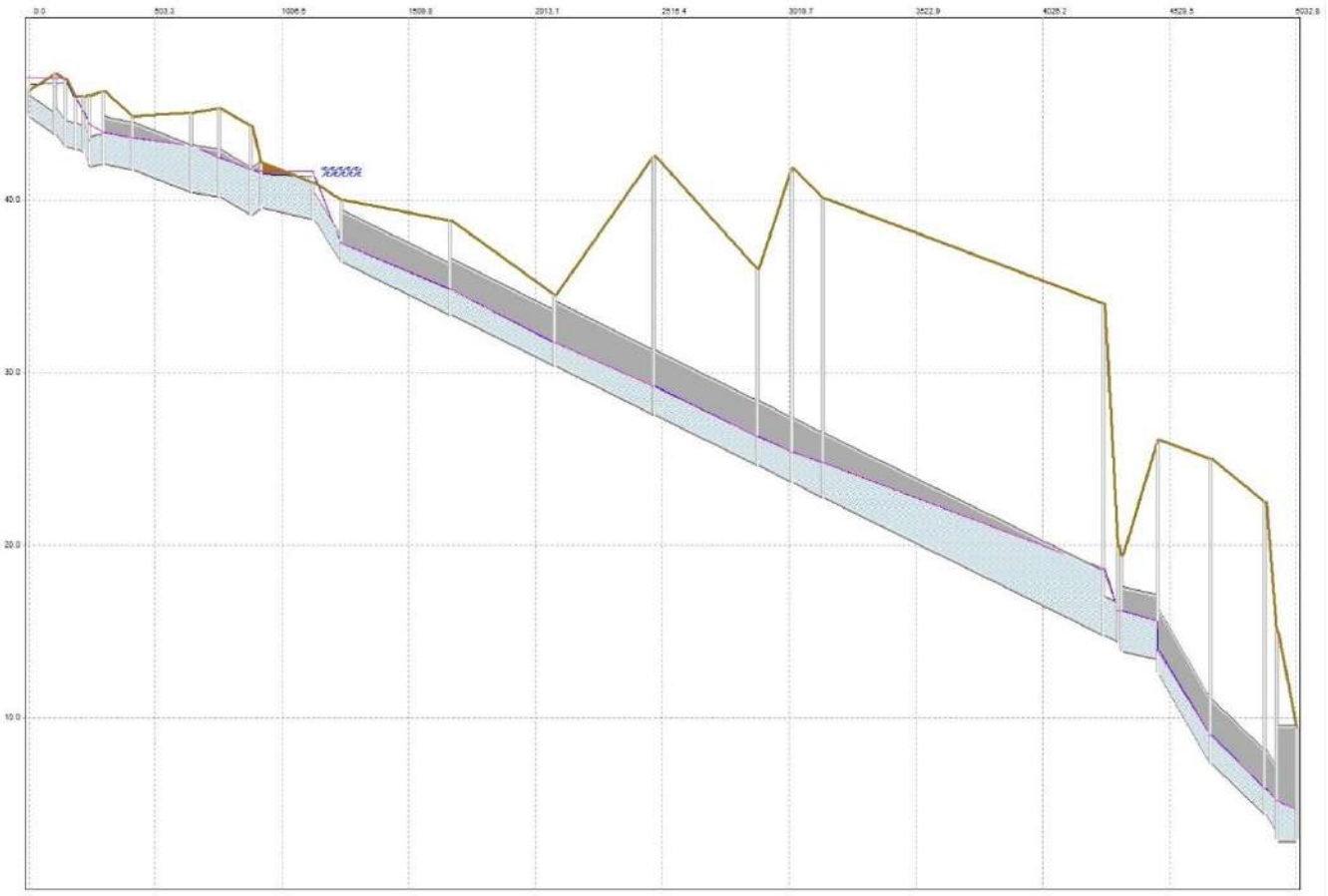


FIGURE 18

Potomac River Profile 18 from 000875ND to 000591IO



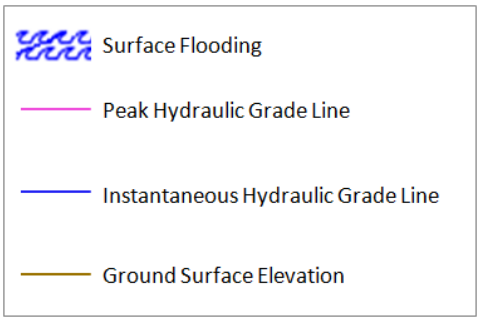
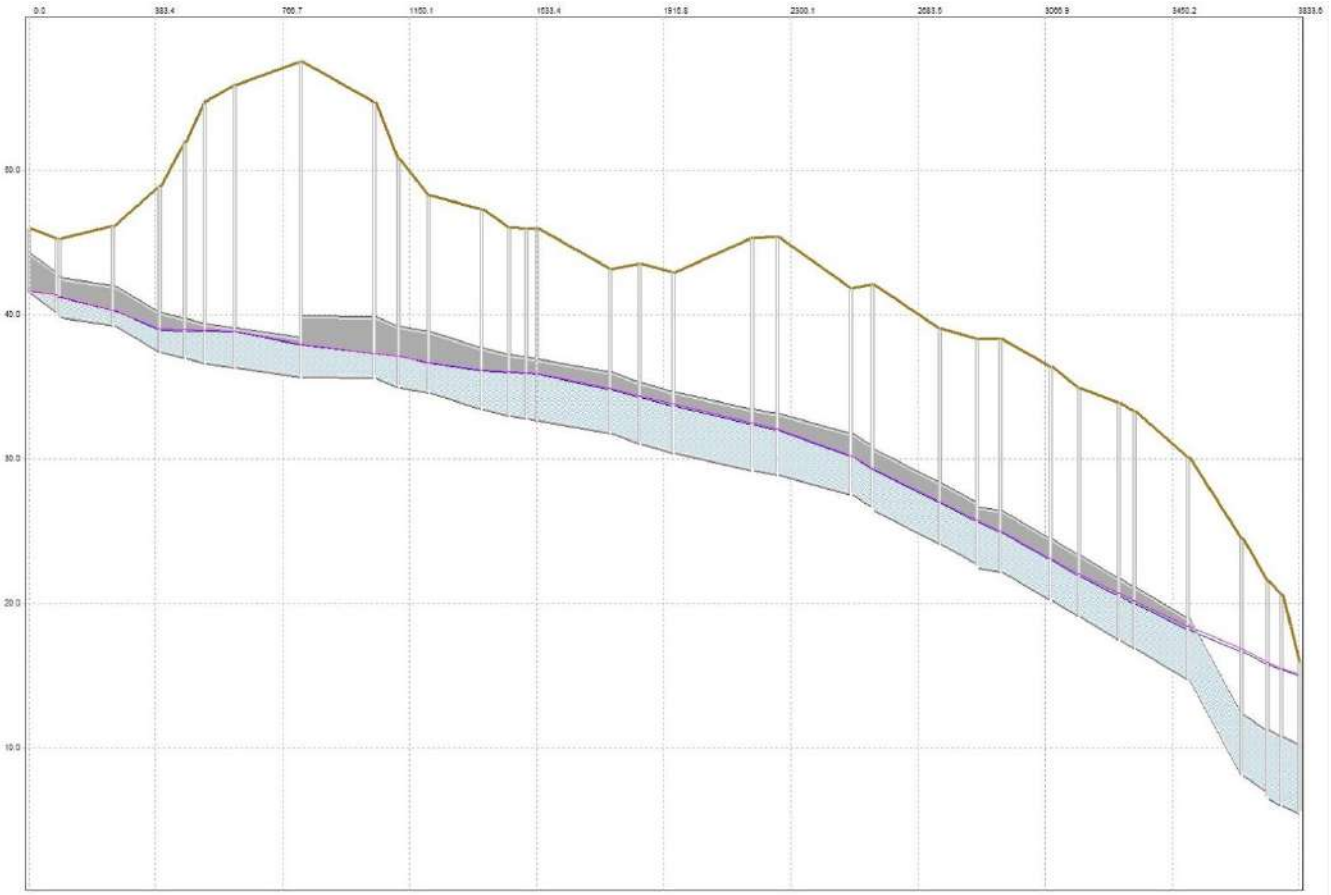


FIGURE 19

Potomac River Profile 19 from 007807IN to 000407IO



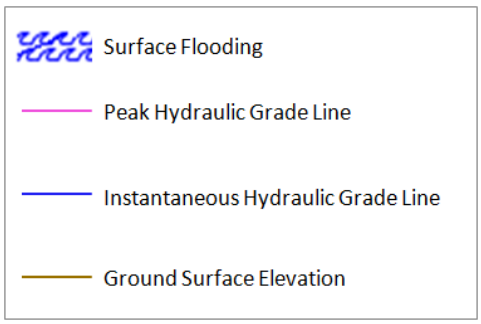
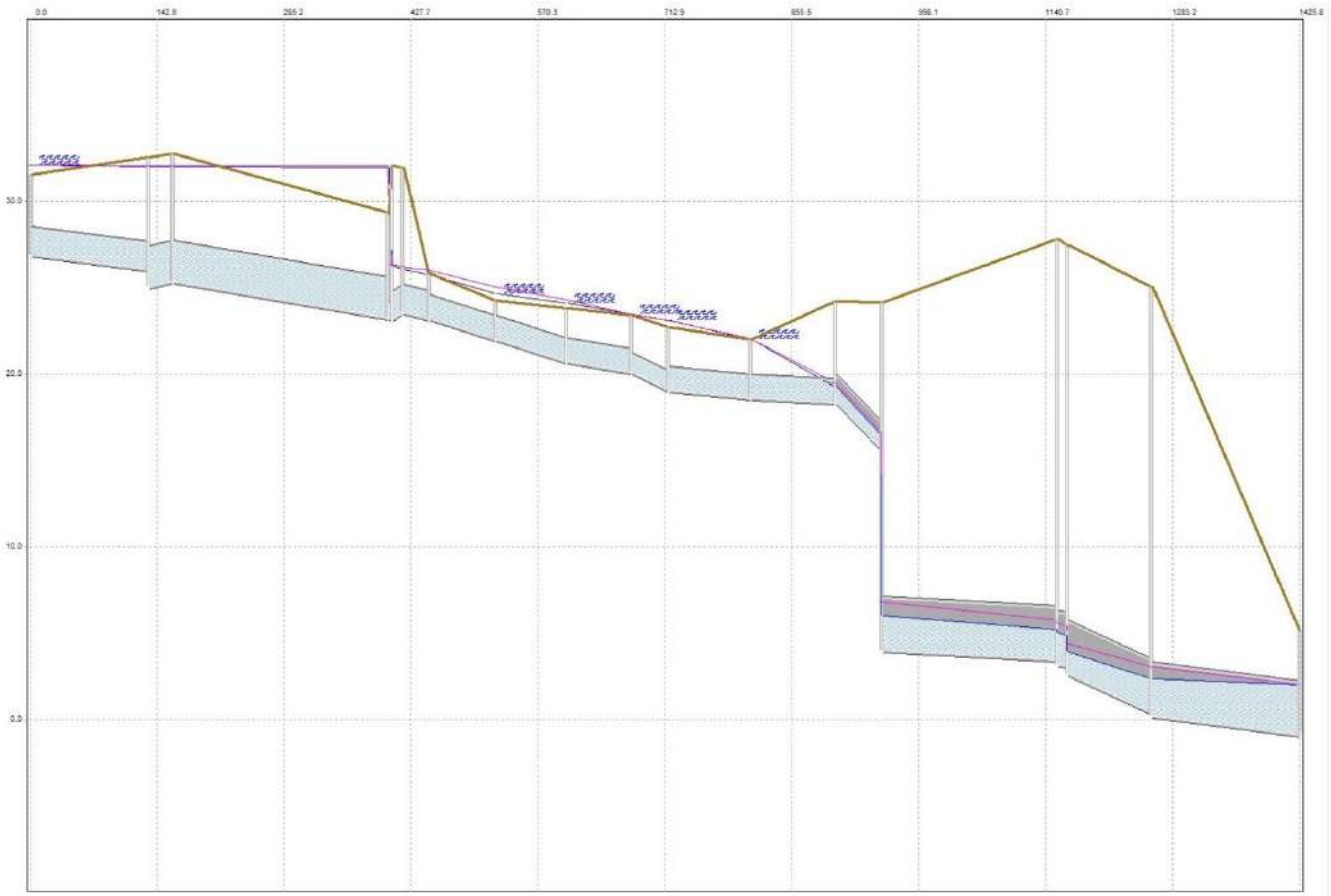


FIGURE 20

Potomac River Profile 20 from 002383SMH to 000471IO



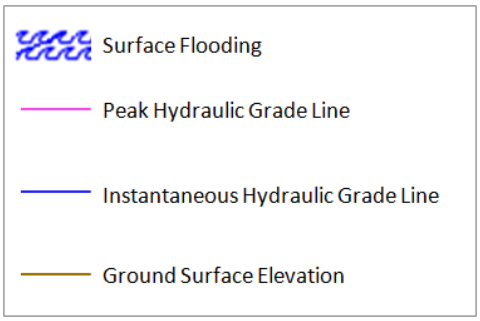
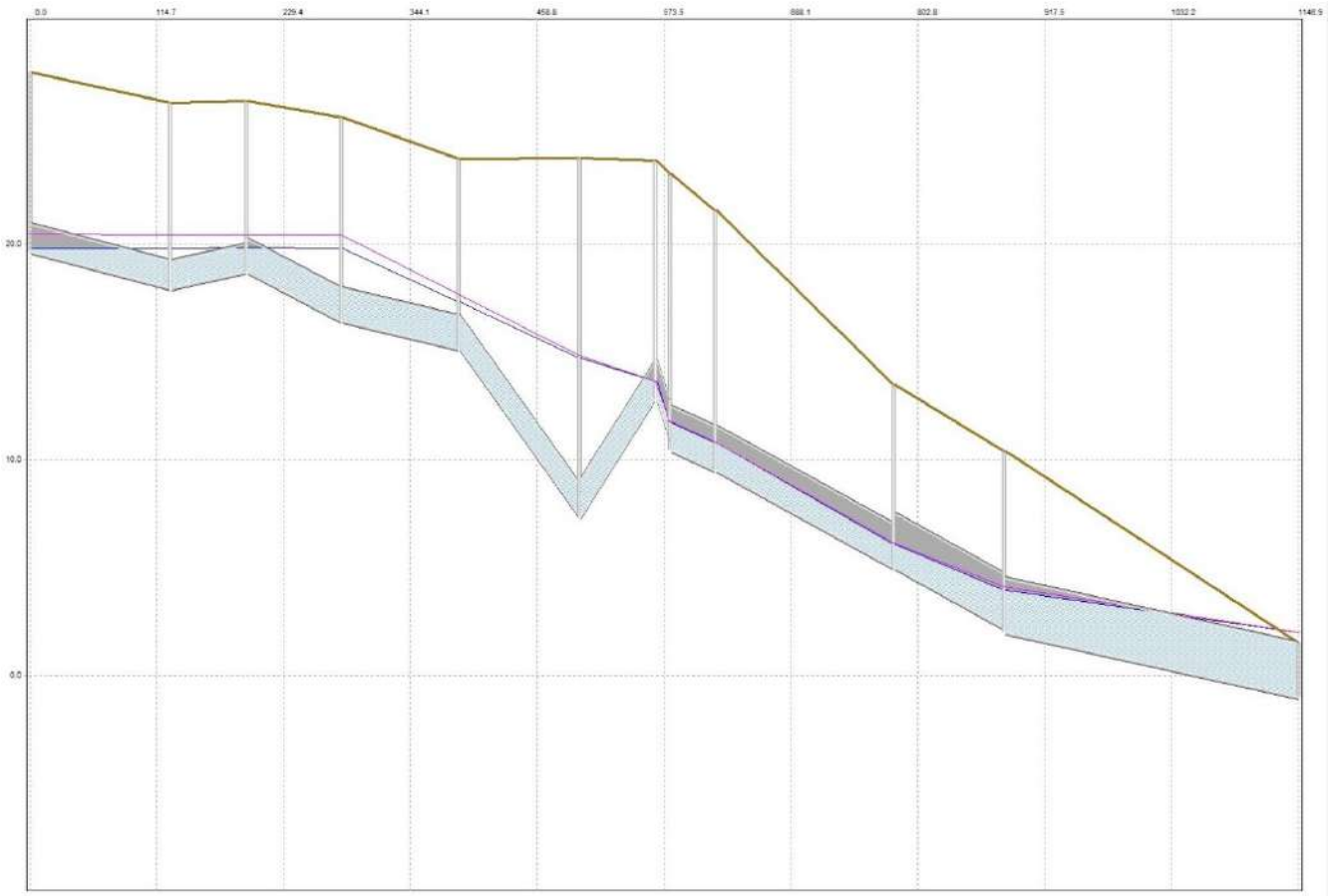


FIGURE 21

Potomac River Profile 21 from 002354SMH to 000469IO



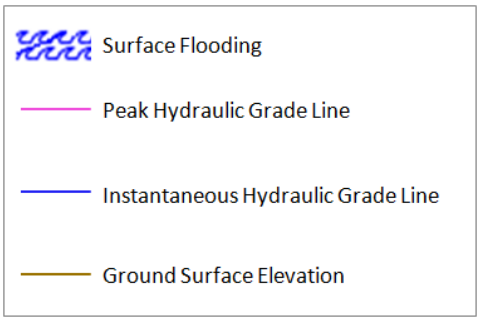
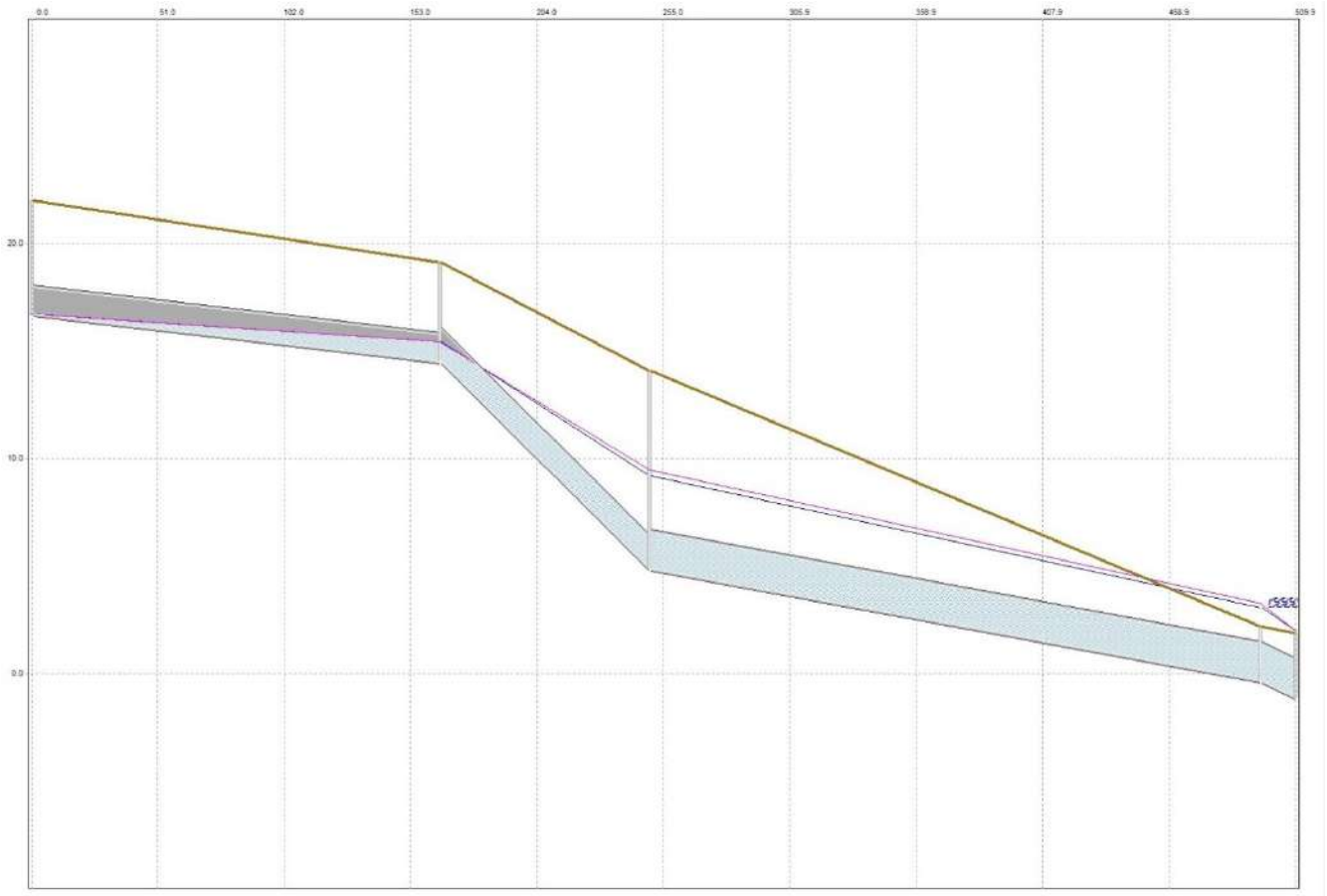


FIGURE 22

Potomac River Profile 22 from 0001062ND to 000470IO



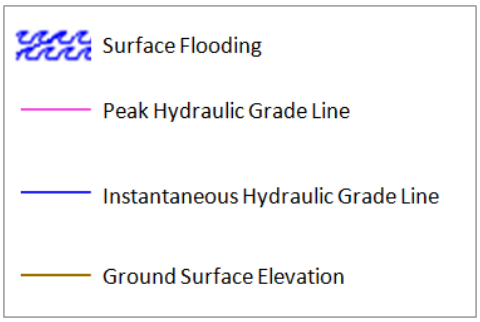
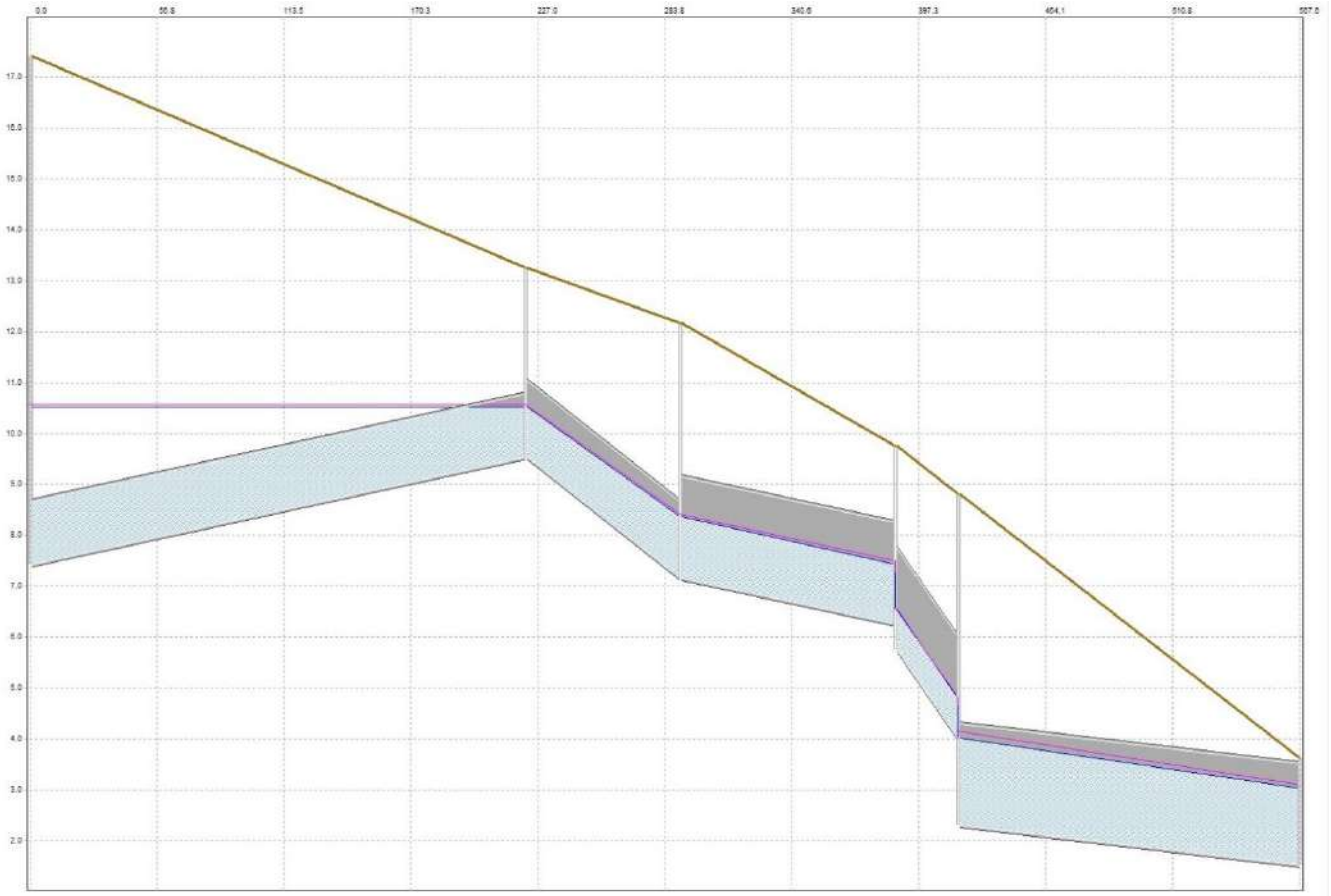


FIGURE 23

Potomac River Profile 23 from 002346SMH to 000481IO



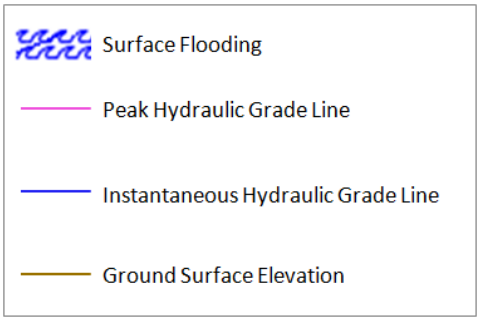
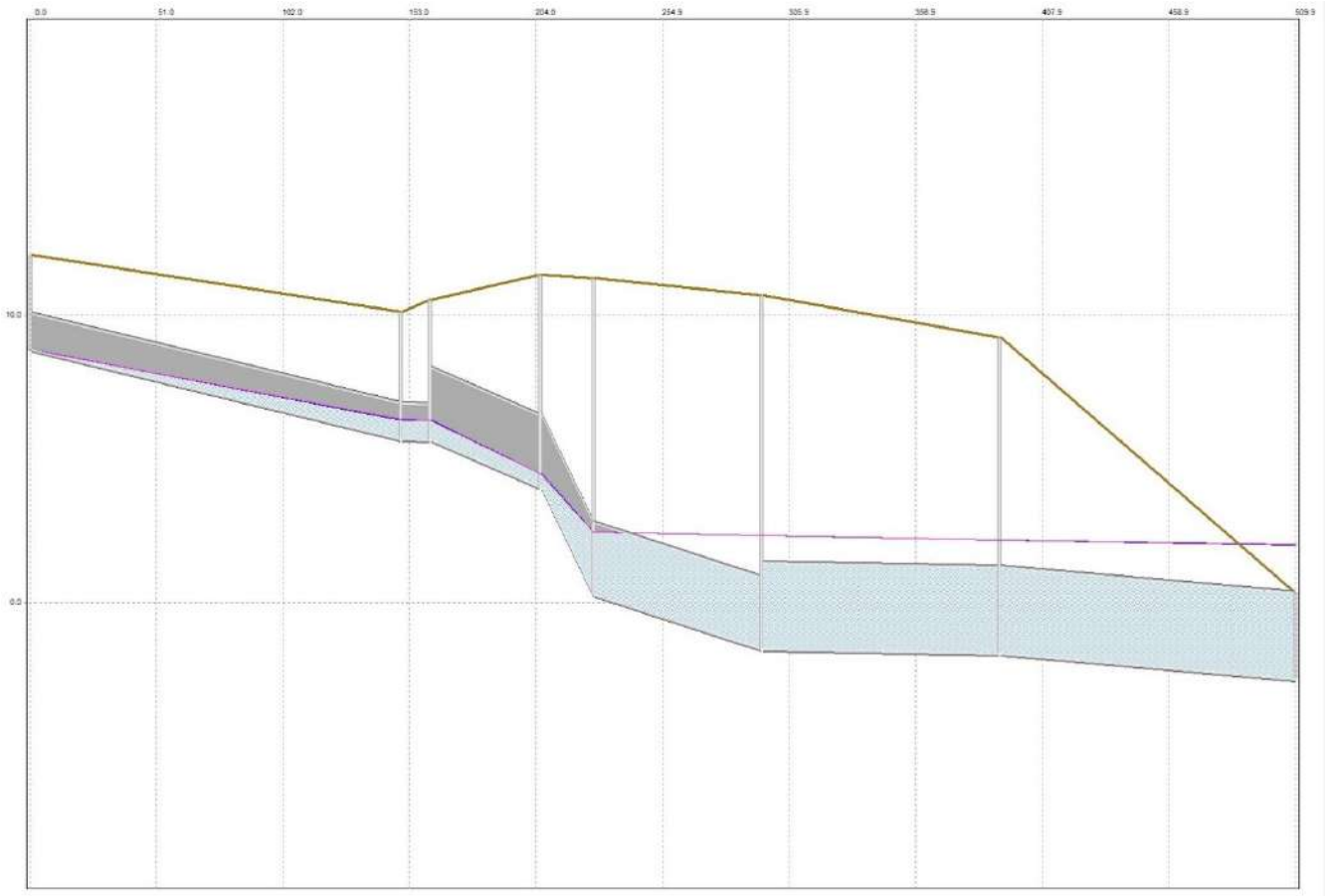


FIGURE 24

Potomac River Profile 24 from 002347SMH to 000480IO



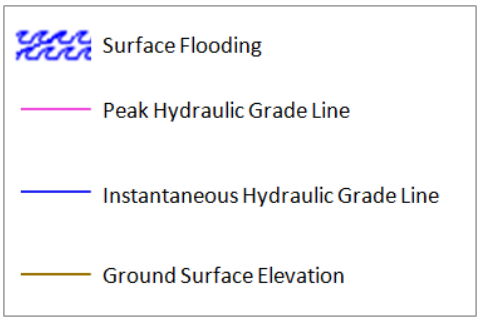
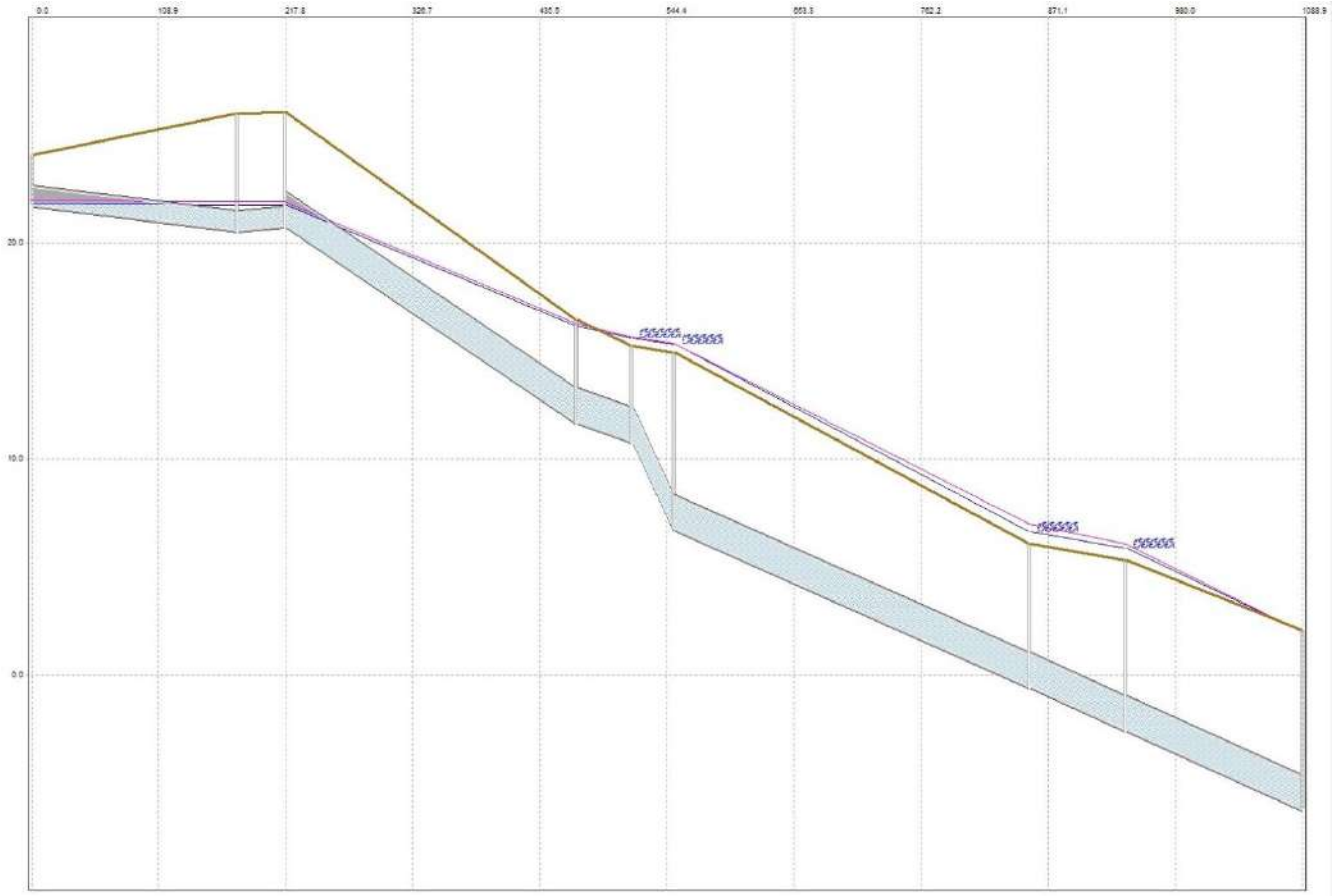


FIGURE 25

Potomac River Profile 25 from 002369SMH to 000479IO



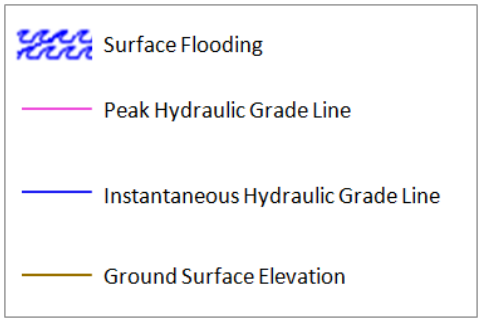
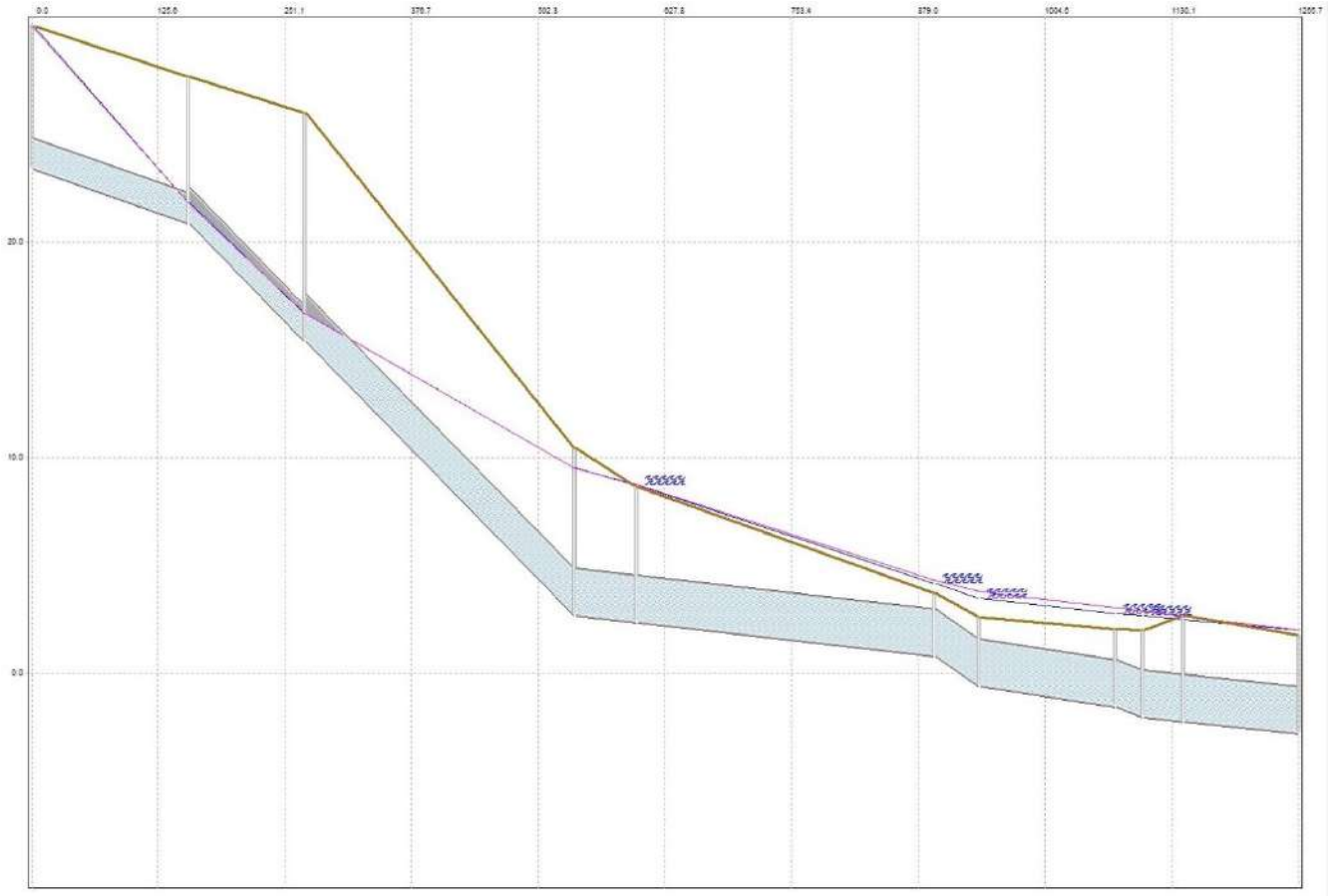


FIGURE 26

Potomac River Profile 26 from 002962SMH to 000487IO



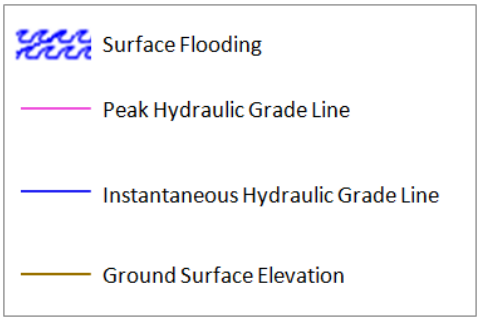
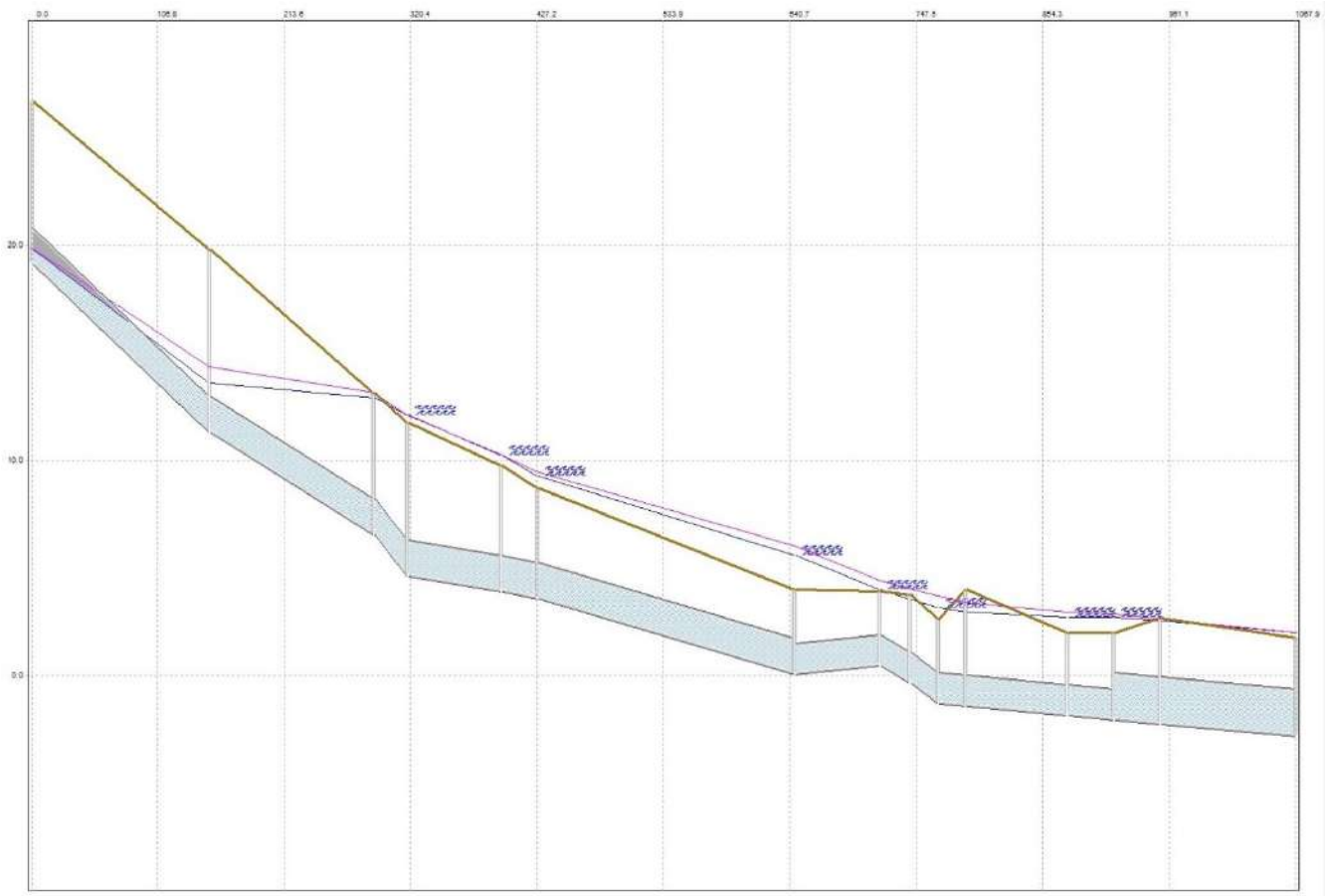


FIGURE 27

Potomac River Profile 27 from 002927SMH to 000487IO



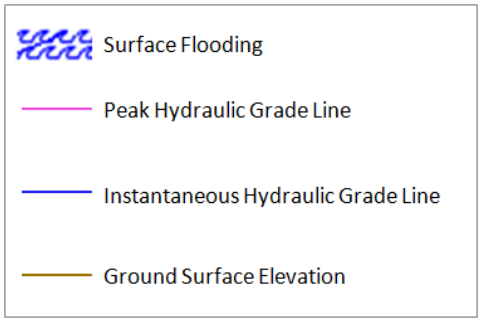
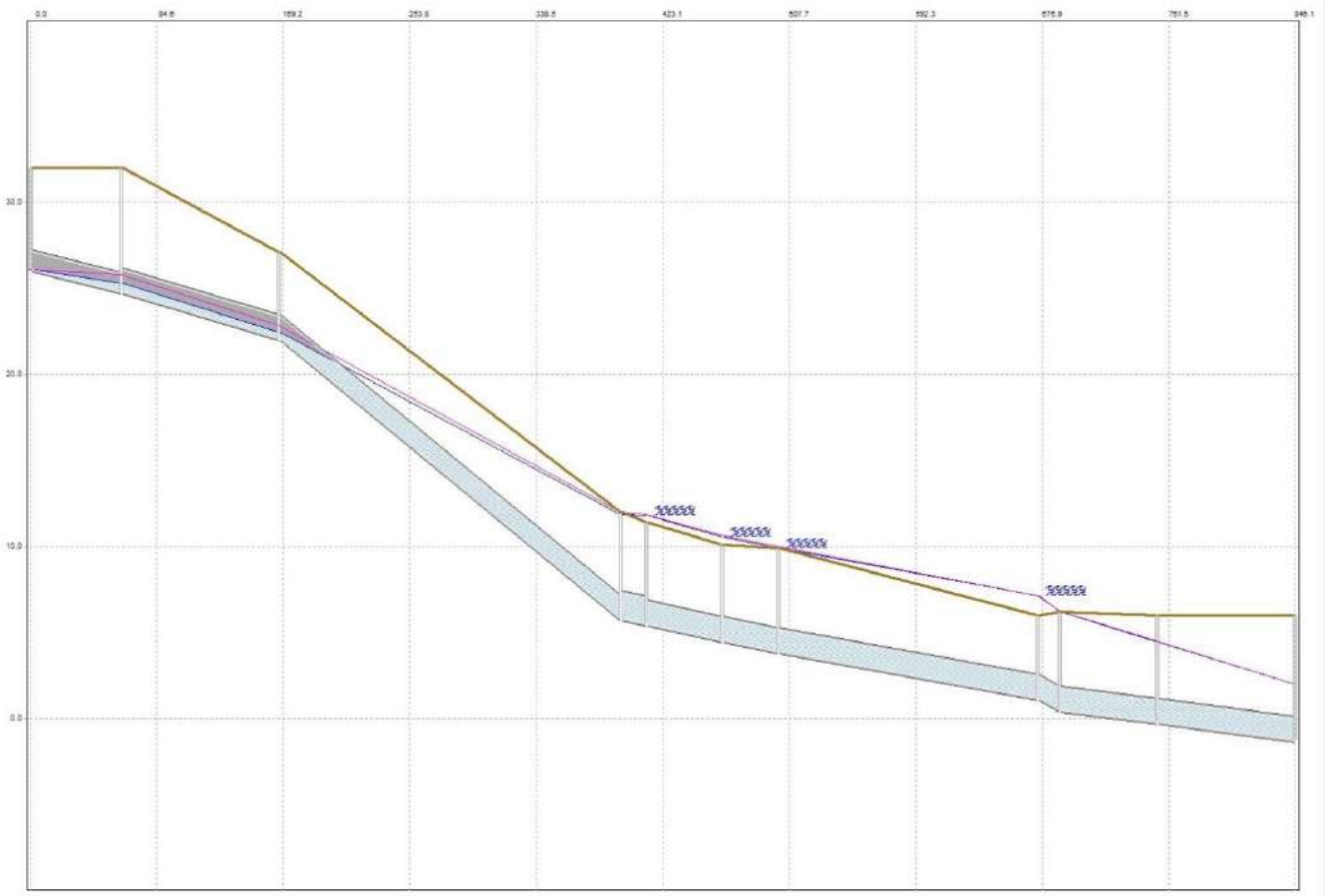


FIGURE 28

Potomac River Profile 28 from 000379CB to 000484IO



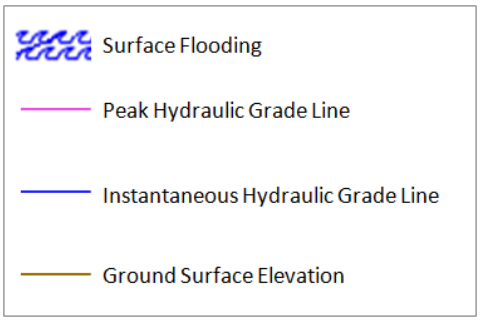
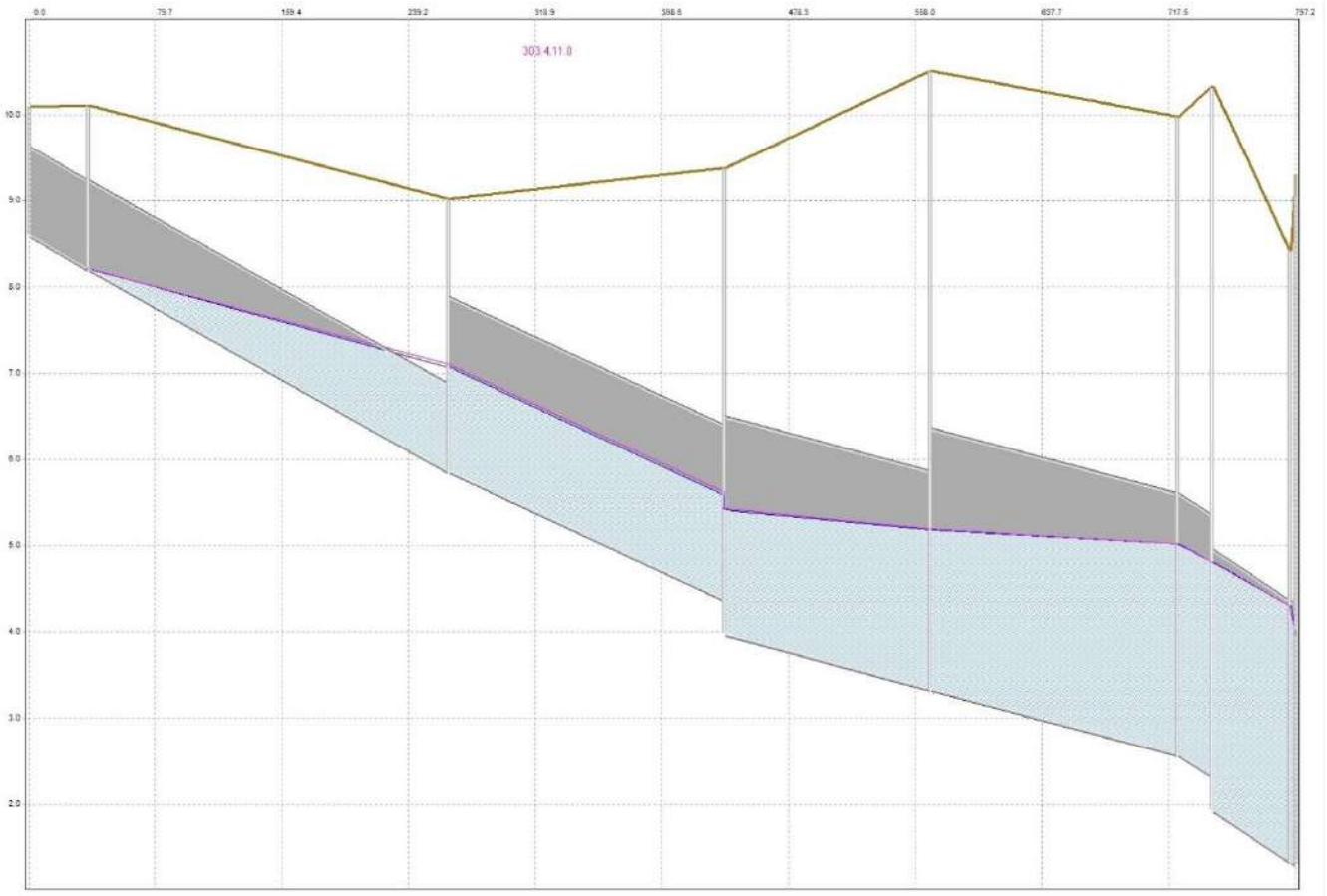


FIGURE 29

Potomac River Profile 29 from 002988SMH to 000495IO



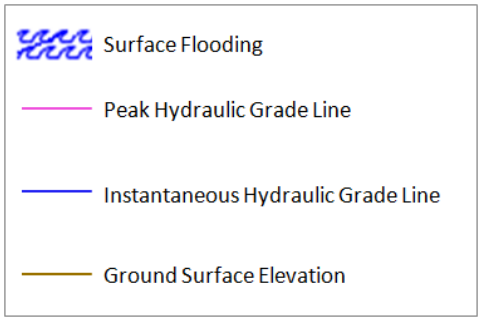


FIGURE 30

Potomac River Profile 30 from 005342IN to 000495IO